

**REVISED HEALTH-BASED REMEDIATION GOAL
EVALUATION FOR INORGANIC CHEMICALS
PRESENT IN SOILS AT ALLIEDSIGNAL, INC.
SOLVENT CENTER SAN DIEGO, CALIFORNIA**

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**HEALTH-BASED REMEDIATION GOAL EVALUATION
FOR INORGANIC CHEMICALS PRESENT IN SOILS
AT ALLIEDSIGNAL, INC. SOLVENT CENTER SAN DIEGO, CALIFORNIA**

1.0 OBJECTIVE AND ORGANIZATION

The objective of health-based remediation goal evaluation for AlliedSignals' Solvent Center (also referred to as Baron-Blakeslee site), hereinafter referred to as the site, is to determine whether residual levels of inorganic constituent (i.e. metals) concentrations are site-related or are representative of natural background. In addition, the generic clean closure values developed by the California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC; Table 1-1) will be evaluated to determine whether they need to be revised to reflect site-specific exposure conditions.

The objectives of this report will be achieved by conducting a health risk assessment (HRA), evaluate the generic clean closure values proposed by DTSC, and provide recommendations on remediation requirements for inorganics. The organization of the report is as follows:

- ▶ **Site History** – Evaluation of the available site historical information to provide insight into the technical and regulatory status of the site which leads to the development of the current HRA.

- ▶ **Health Risk Assessment** – Evaluate the potential health risks associated with current and future exposure to site-related contamination, which in turn will provide the necessary information to determine the potential cleanup criteria for the site.
 - **Site Characterization/Hazard Identification** – Describe the results of the inorganic constituents detected at the site and compare the results to background concentrations.
 - **Exposure Pathway Analysis** – Identify the current and future reasonable maximum exposure scenarios expected to occur at the site and calculate potential inorganic chemical intakes associated with these exposures.

- **Toxicity Evaluation** – Identify and summarize the available dose-response information of the inorganics detected at the site.
 - **Risk Characterization** – Calculate potential health risks associated with the current and future exposure pathways to compare site risks with background risks to determine if remediation of inorganics in soil is required to reduce site risks to background risk levels.
 - **Uncertainty Analysis** – Summary of uncertainties inherent in the HRA process are summarized.
-
- ▶ **Development of Health-Based Soil Remediation Goals (HBRGs)** – Develop HBRGs based on Cal-EPA risk assessment guidance and compare to on-site and background concentrations of inorganics.
 - ▶ **Conclusions and Recommendations** – Present conclusions and recommendations for no action or additional investigation based on an evaluation of background levels and the development of HBRGs.

2.0 SITE HISTORY

The site was an industrial waste management firm that stored, treated, and recycled waste solvents located in the City of San Diego, San Diego County, California. The facility occupies approximately 1.5 acres of land located in an area zoned for manufacturing-small industry. The facility consists of an office and two warehouses on property located north of the Santa Fe Railroad tracks; a tank farm is located across from the main buildings. The facility was used to store spent solvents for re-refining by distillation or disposal. Surrounding businesses include a pottery studio, a surfboard shop, and an art and craft manufacturer. Interstate 5 is located approximately 200 feet northeast of the site; and the San Diego International Airport is approximately 600 feet south of the facility (Figure 1).

The site is regulated under the RCRA program. In February of 1992, the DTSC Region 4 conducted a Visual Site Inspection (VSI) of the facility. Results of this VSI were combined with a Preliminary Review to develop a RCRA Facility Assessment (RFA) report in April of 1992, which identified 10 solid waste management units (SWMUs) as areas of concern at the site to include:

SWMU No.*	SWMU Description
1	Hazardous Container Storage Area
3	Process Still Area
4	Wash Water/Storm Water Holding Tank
5	Container Rinsing Area
6	Sump/Drainage Ditch
7	Empty Container Storage Area
8	Shipping and Receiving Area
9	Old Container Storage Area
10	Old Spent Solvent Distillation System
11	Old Empty Container Storage Area

* SWMU No. 2 was a proposed unit.

As a result of the RFA, DTSC determined that 7 SWMUs (Nos. 5, 6, 7, 8, 9, 10, and 11) be further evaluated in a Phase I RCRA Facility Investigation (RFI) to determine the presence or absence of contaminants (i.e. volatile organics) in soil. The results of the Phase I RFI will be used to determine whether releases have or have not occurred in the vicinity of these SWMUs, as well as, be used to determine if further investigation is warranted (i.e. Phase II RFI). The remaining three SWMUs (Nos. 1, 3, and 4) were identified by DTSC as hazardous waste management units and are to be addressed as part of the Site Closure Plan detailed in the RCRA Part B Permit.

The primary contaminants of concern at all 10 SWMUs are the presence of volatile organic solvents, however, during a site review meeting in December of 1993, DTSC requested further evaluation of the inorganics present at the 10 SWMUs, since several parameters of specific concern, arsenic, cadmium, and lead, appear to be above DTSC's generic Clean Closure Values. Clean closure levels are health-based derived environmental concentrations that are protective of human health under residential exposure conditions. As a response to DTSC's request for further evaluation of arsenic, cadmium and lead, this report was generated to evaluate background concentrations of all inorganics detected at the site and determine if the generic clean closure values need to be refined. The objective of this evaluation is to determine if the site-wide distribution of inorganics is uniformly distributed and within naturally occurring levels, and determine if some or all of the inorganics require remediation. If the inorganics are determined to be representative of background/regional conditions, it is inappropriate to consider remediation for those "background" chemicals.

3.0 HEALTH RISK ASSESSMENT

An HRA was conducted on the inorganic constituents identified in site soils collected during closure sampling and sampling conducted as part of the site-wide RFI investigations, to determine the health risks associated with potential exposure to residual levels of inorganics. The HRA was conducted following USEPA Risk Assessment Guidance for Superfund (RAGS) (EPA, 1989, 1991a, 1991b) and DTSC guidance (DTSC, 1993b, 1994). The accepted procedure for site-specific HRA consists of four elements: (1) site characterization/hazard identification, (2) toxicity assessment, (3) exposure assessment, and (4) risk characterization. The presentation of the HRA on the inorganics is organized by these elements.

3.1 SITE CHARACTERIZATION / HAZARD IDENTIFICATION

This step typically determines which of the chemicals detected at a site pose the most critical health concerns based on a number of site-specific and chemical specific factors to include: toxicity, mobility, persistence, frequency and location of detection, and the concentration levels detected. Focusing on these chemicals in the HRA allows for the most effective use of the available information resources and ensures that the most hazardous conditions of a site are addressed. This focused approach is based on the premise that remediation of the site to reduce levels of the most toxic constituents at the site to acceptable concentrations, will also result in acceptable concentrations of other similar but less hazardous compounds identified at the site. Historical information is useful in selecting the potential compounds to be expected in the environment of the site.

The hazard identification is a complex process involving several systematic analytical steps, which are covered under two major steps in RAGS, namely (1) Data Collection and (2) Data Evaluation (EPA, 1989). The ultimate goal of this process is to develop a set of data that can be used for quantitative HRA. The final list of chemicals selected from the analytical results using the above listed data evaluation process is referred to as chemicals of potential concern (COCs). This evaluation consists of the following subtasks:

1. Reviewing historical use (i.e., waste streams received or generated at the site) of inorganics at the site;
2. Summarizing the inorganic analytical data collected at the site; and
3. Evaluation of the analytical data with respect to sample quantitation limits, and comparing potential site-related contamination with established background concentrations.

3.1.1 Historical Use of Inorganics at the Site

This section discusses the site related historical activity at the site, which might have contributed to the presence of inorganics in the soil sampled at the site (Figure 1).

3.1.1.1 Sites Proposed for Clean Closure

Hazardous Container Storage Area (SWMU No.1)

The container storage area is located inside of Warehouse No. 2 measuring 105 by 40 feet. The warehouse is an enclosed building constructed with corrugated sheet metal which minimizes the container exposure to direct sunlight and weathering etc. The entire warehouse flooring is constructed with four-inch thick concrete and surrounded by a four-inch high berm. The hazardous wastes were stored until they were recycled, treated or disposed. The warehouse also houses SWMU No. 3 (spent solvent distillation system).

The warehouse was installed in late 1984. The solvents formerly stored are reported to be mostly halogenated volatile organic solvents such as: 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, methylene chloride, trichlorofluoroethane, dichlorofluoroethane, acetone, ethanol, methanol, xylene, ethyl acetate, butanol, methyl isobutyl ketone, methyl ethyl ketone, toluene, isopropanol (DTSC, 1992). Based on the findings of the RFA, potential soil contamination from the SWMU No. 1 is limited to soil under the concrete of the building. Based on a review of the RFA, none of the site-related operations at this SWMU involved use of metals.

Process Still Area (Spent Solvent Distillation System) (SWMU No.3)

The spent solvent distillation system is located inside of Warehouse No. 2. The distillation system comprises of a still, feed tank, and water separator. Water, alcohol and other impurities are separated inside the separator via specific gravity.

This SWMU was established in late 1984. This spent solvent distillation system has reclaimed spent solvents such as 1,1,1-trichloroethane, methylene chloride, tetrachloroethylene, trichloroethylene, and trichlorofluoroethane. Based on a review of the RFA, none of the site-related operations involve use of metals.

Wash water/Storm water Holding Tank (Neutralization Tank) (SWMU No. 4)

The neutralization tank is located approximately 80 feet northwest of Warehouse No. 2. The SWMU is an open-top in-ground tank and is constructed of concrete. A portion of the tank is situated below ground level. The tank is coated with fiberglass resin to increase the acid resistance of the unit.

Since its installation in 1972 until 1988, the tank was utilized to accumulate acid rinse water from the cleaning of acid containers, storm water runoff, and truck wash (exterior) water. Acid operations ceased in 1988, however, the neutralization tank was maintained in lieu of partial closure for storm water and truck wash water storage. The wastes managed included: acidic wastewater which may contain trace levels of metals and halogenated volatile organic solvents. There is no documented release from the site to the soil, however the repaired cracks noted during the visual site inspection lead the DTSC inspectors to suspect a potential (unnoticeable) release to the soil from the underground portion of the tank.

3.1.1.2 Sites Evaluated in the Phase I RFI

Container Rinse Area (SWMU No. 5)

This unit is a 10 by 30 feet elevated concrete pad located adjacent to SWMU. No. 4. in the southwestern corner of the facility. The pad was used to rinse containers received from off-site facilities containing acidic wastes from plating operations. Thus, the wastes may have contained

metals, and muriatic, nitric, and sulfuric acids. There is no file evidence of release from this SWMU.

Sump/Drainage Ditch (SWMU No. 6)

This unit consists of a yard drainage collection ditch terminating at an open, subsurface sump located in the southwestern perimeter of the facility. The concrete-lined ditch is approximately 180 feet long and transects the facility yard to receive and transport surface runoff to the sump. This unit was used to control and direct storm water and surface drainage in the facility yard to the sump, where it was subsequently pumped out and stored in the neutralization tank (SWMU No. 4). SWMU No. 6 was used to collect storm water and liquid generated from washing the exterior of hazardous waste deliver trucks. Since the facility stored virgin chemical and empty containers in the facility yard, spillage of virgin chemicals and rain water in contact with hazardous waste residues from empty containers could have accumulated in the sump. Therefore, this unit could have contained corrosives, metals, halogenated volatile organic, and nonhalogenated volatile organic solvents.

Empty Container Storage Area (SWMU No. 7)

This area is a concrete-paved storage area for empty drums located along the northeast fence of the virgin chemical tank farm, north of the main facility. The area is bermed on three sides with the unbermed fourth side leading to a subsurface drain which discharges into the secondary containment system for bulk virgin chemical storage. A 15-foot long crack was observed in the eastern portion of the unit during the VSI. This area was used to store empty 55-gallon drums which contained virgin and/or spent solvents. There is no file evidence of release from this SWMU. Residual materials in these drums may include metals, halogenated volatile organic and non-halogenated volatile organic solvents.

Shipping and Receiving Area (SWMU No. 8)

This unit consists of a 60 by 20 feet concrete-floored work area between Warehouse No. 1 and Warehouse No. 2, and an asphalt-paved facility yard located in front of the north-facing access to a covered work area. This unit was used for temporary staging for shipping and receiving

all materials for the facility. There is no release control at this SWMU and cracks were observed on the concrete floor. The unit is currently inactive. Wastes managed may include metals, halogenated volatile organic and non-halogenated volatile organic solvents.

Old Container Storage Area (SWMU No. 9)

This unit is an asphalt-paved area in the eastern portion of the facility used for storage of aged and empty containers. This unit is currently inactive. The types of waste stored in this area included formic acid, halogenated volatile organic and non-halogenated volatile organic solvents.

Old Spent Solvent Distillation System (SWMU No. 10)

This area was located inside the southern end of Warehouse No. 1. The SWMU consisted of a 120-gallon still and a 500-gallon feed tank. The still was used to reclaim spent solvents for recycling; the feed tank was used for the temporary holding of batch liquids prior to distillation. The types of wastes managed include tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, trichlorofluoroethane and dichlorofluoroethane. Currently this area is used for storing virgin chemicals.

Old Empty Container Storage Area (SWMU No. 11)

This area was located along the north fence of the facility. Empty drums were stacked on their sides up to four tiers high. The entire area was not paved and empty containers and virgin acids and bases in drums were stored on bare ground. The hazardous wastes of primary concern included spent solvents and corrosives which may contain metals. Storage of empty containers was discontinued in 1984.

3.1.1.3 Summary of Historical Use of Inorganics

The evaluation of historical information allowed for the identification of the types of waste streams treated, stored, or disposed of at the 10 SWMUs. The site history indicated that only one of the SWMUs proposed for closure, SWMU No. 4 [Wash Water/Storm Water Holding Tank (Neutralization Tank)], handled metals as part of the waste stream. However, historical use of metals has been identified at five of the seven SWMUs undergoing RFI investigations.

These SWMUs include No. 5 (Container Rinse Area), No. 6 (Sump/Drainage Ditch), No. 7 (Empty Container Storage Area), No. 8 (Shipping and Receiving Area), and No. 11 (Old Empty Container Storage Area). A summary of the waste streams associated with the site is presented in Table 3-1.

The inorganics (i.e., metals and nonmetals) detected in soil samples collected at the facility include arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. According to the manufacturing/use information presented for each of the eight inorganics in the Hazardous Substance Data Bank [(HSDB); DHHS, 1994)], all eight inorganics may be associated with metal plating wastes, the manufacture of metal alloys/amalgams, and/or are by-products of corrosive wastes. Specifically, arsenic is used as a constituent in the manufacturing of alloys, as are barium, cadmium, chromium, lead and selenium; mercury is used predominantly in a variety of amalgams with other metals (i.e., cadmium-mercury amalgam). Inorganics commonly used in the electroplating industry include cadmium, chromium, and silver. Except for metal plating operation wastes present at SWMU No. 5, the historical information does not specify from what manufacturing processes the acid wastes and spent solvents were generated, therefore, all inorganics detected at the site were evaluated quantitatively in order to determine whether the presence of these compounds in soil is due to site-related chemical releases or the detected levels are representative of background conditions.

3.1.2 Summary of Soil Sampling Investigations

Three rounds of soil samples were collected at the facility (Figure 1) and include:

- Closure Borings at SWMUs No. 1, 3, and 4
- RFI Phase I Soil Borings
- RFI Phase I Supplemental Borings

The initial round of sampling was performed to investigate SWMUs Nos. 1, 3, and 4 prior to RFI sampling (Appendix A). The samples collected at this time were from subsurface soils beneath the foundation of these three SWMUs. The depth of the samples is in feet and denoted by the last number in the sample identification number (Sample ID)(i.e. sample W2C-3-18 was

collected at 18 feet). The samples included during this round are:

SWMU No. 1	W2C-3
SWMU No. 3	W2C-1, W2C-2
SWMU No. 4	ST-1, ST-2

The remaining samples were collected as part of the RFI. Sample identifications refer to the SWMU number at which they were collected, the boring number, and the depth of the soil boring. For example the sample S1-B1-0.5 corresponds to SWMU No. 1, boring number 1 collected at a depth of 0.5 feet (Appendix B). The borings include:

SWMU No. 1	S1-B1
SWMU No. 5	S5-B1, S5-B2, S5-B3 and S5-B4
SWMU No. 6	S6-B1, S6-B2, S6-B3, S6-B4 and S6-B5
SWMU No. 7	S7-B1, S7-B2, and S7-B3
SWMU No. 8	S8-B1, S8-B2, S8-B3, S8-B4, S8-B6 and S8-B7
SWMU No. 9	S9-B1, S9-B2 and S9-B3
SWMU No. 10	S10-B1 and S10-B2
SWMU No. 11	S11-B1, S11-B2, S11-B3 and S11-B4

In relation to surface topography, five additional soil borings were drilled and sampled as part of the RFI at locations downgradient from SWMUs and are denoted as AA-B (Appendix B). The ground surface topography generally slopes from north to south. The virgin chemical tank farm is located at the highest on-site elevation to the north, while the railroad tracks are located at the lowest area, the southwest portion of the site. These samples include:

Virgin Chemical Tank Farm	AA-B1, AA-B2, AA-B3
Area south of SWMU No. 8 along the railroad tracks	AA-B4
Area south of Warehouse No. 2 along the railroad tracks	AA-B5

3.1.3 Comparison with Background Samples

Background samples serve as a baseline measurement to determine the degree of contamination. Generally, background samples are collected and analyzed for each medium of concern in the same manner as other site samples. Background samples differ from other samples because the sampling location is intended to be in an area that has not been exposed to the source of contamination. As the site is surrounded by manufacturing-light industry, it is difficult to determine "background" conditions. However, site soil samples may be evaluated to determine the relative significance of the level of inorganics detected on site by comparing on-site concentrations to regional naturally occurring levels. If the site concentrations are representative of naturally occurring levels, then that chemical may not require further evaluation in the corrective action process. Statistical analysis of the site data was performed to determine if the site levels are distinctly different from the background levels.

Because the eight inorganics detected in soil could be constituents of the waste streams associated with the site (Table 3-1), all eight chemicals were included as COCs in the HRA to determine if some or all could be eliminated from further corrective action considerations.

While currently there is no human exposure to soil at the site, as the entire site is capped (i.e., paved), the comparison of on-site inorganic concentrations (potential future exposure concentrations) to background concentrations, was conducted in the event that the cap is removed and the site is used for future industrial or residential purposes. Thus, for this analysis soil samples collected within 0-3 feet from the surface are evaluated. Samples 0-10 ft were not used for the residential land use evaluation, because inclusion of the deeper samples would dilute the potential exposure concentrations due to the fact that a majority of the deeper samples are below detection. This is in agreement with DTSC HRA guidance (DTSC, 1993b) for residential-use scenarios, which states that "surface samples or depth-weighted average concentrations down to 10 feet below the surface, whichever is greater, should be used in exposure calculations."

Background levels for the state of California were obtained from data summarized by Dragun and Chiasson, 1991 in "Elements in North American Soils." This reference was designed to

serve as a reference for baseline data where site-specific data do not exist. The data represent total concentrations of an element in surface soil (Horizon B) and were obtained from U.S. Geological Survey (USGS) publications. The data are presented by State and regions within a state along with the sample ranges, arithmetic mean, and standard deviations. The geometric mean provides a better estimate of central tendency in lognormal populations, however it gives a poorer estimate of the geochemical abundance of an element, therefore, the arithmetic mean is presented for comparison. The standard deviation provides a measure of dispersion of observations around the mean.

The background analysis was performed separately for the SWMUs identified for Closure and the SWMUs identified for RFI analysis. The number of samples available from the three SWMUs proposed for closure (Nos. 1, 3 and 4) are limited. Thus, to compare the inorganic concentrations near these sites to naturally occurring levels, samples were pooled from SWMUs located nearby to include SWMUs Nos. 1, 4, 5, 6, 8 and 11 (Table 3-2). To compare the levels of inorganics detected at the RFI SWMUs, samples collected site-wide were analyzed statistically for the metals (Table 3-3).

The summary of the background analysis is presented as follows.

3.1.3.1 Arsenic

Arsenic, occurs uniformly across the area, and the concentrations are at the naturally occurring levels. Arsenic was detected in all the soil samples collected at the site. The detected levels of arsenic are uniform across the different SWMUs. Although site specific "background" samples are not available, site-wide arsenic distribution, when compared with the California naturally occurring levels in surface soil, does not exceed the "naturally" occurring levels for the pooled site (Table 3-2) data as well as for the site-wide comparison (Table 3-3). These results indicate that arsenic is not a source-related contribution, rather it is representative of regional concentrations.

The mean and maximum concentrations of arsenic are 3.1 milligrams per kilogram (mg/kg) and 9.3 mg/kg, respectively for the pooled data (Table 3-2) and 3.8 mg/kg and 21.3 mg/kg, respectively for the site-wide data (Table 3-3). The mean and maximum concentrations of the naturally occurring arsenic for California soils is 6.6 mg/kg and 69 mg/kg, respectively (Dragun and Chiasson, 1991). These results indicate that the levels of arsenic are well within the naturally occurring levels, and does not indicate a source related contribution. However, the DTSC clean closure levels of 0.3 mg/kg, which accounts for the toxicity of the metal, is lower than the site concentrations. Thus, both background and site concentrations of arsenic were further evaluated in the risk assessment for proper perspective on the toxicity related issues.

3.1.3.2 Lead

As with arsenic, lead was detected uniformly across the site, and the concentrations are at the naturally occurring levels. Lead was detected in 22 out of the 35 samples collected as part of the pooled data, and none of the samples indicated lead levels above the naturally occurring levels (Table 3-2). The mean and maximum concentrations of lead are 23.8 mg/kg and 150 mg/kg, respectively for the pooled data (Table 3-2) and 85.7 mg/kg and 3,720 mg/kg, respectively for the site-wide data (Table 3-3). The corresponding levels for California soils is 29 mg/kg and 300 mg/kg, respectively (Dragun and Chiasson, 1991). These results indicate that the mean levels of lead are well within the naturally occurring levels, and does not indicate a source related contribution. However, soil samples collected along the railroad track had elevated levels of lead in two samples: 3,720 mg/kg in S9-B3-1 (surficial soil sample, 1 foot) and 5,780 mg/kg in AA-B4-5 (a deeper soil sample, 5 feet). Occurrence of these high levels of lead does not appear due to SWMU-related activities because shallow and deep samples collected at the same locations are below detection (i.e., S9-B3-5, S9-B3-10; AA-B4-3, AA-B4-10).

Due to the presence of these elevated levels, however, additional sampling was conducted as part of the most recent Phase II RFI sampling effort to ascertain whether the two elevated levels of lead detected in AA-B4-5 and S9-B3-1 are hot spots or whether these levels are outliers. During the Phase II investigation a boring, AA-B10, was collected adjacent to boring location AA-B4;

four samples were collected at varying depths at this location to include 1 foot, 3 feet, 5 feet and 10 feet. The analytical results indicate that lead was detected at 4.2 mg/kg in the 1 foot sample (AA-B10-1) and was below detection (with a detection limit of 2.6 mg/kg) in the other three samples (AA-B10-3, -5, and -10). Thus, based on the Phase II results, it appears that the two elevated lead levels are outliers and not related to the site.

During the Phase II investigation, three borings, S9-B4, S9-B5, and S9-B6, were collected adjacent to boring location S9-B3; two samples were collected from each boring, one at 1 foot and one at 3 feet. The analytical results indicate that the lead concentrations ranged from 14.7 mg/kg in S9-B6-3 to 585 mg/kg in S9-B5-1 (See Table B-2). Thus, based on the Phase II results, it appears that the two elevated lead levels are outliers and not related to the site.

Because the DTSC clean closure levels of 130 mg/kg, which account for the toxicity of the metal is lower than the site concentrations, both background and site concentrations of lead were further evaluated in the risk assessment for proper perspective on the toxicity related issues.

3.1.3.3 Cadmium

Unlike arsenic and lead, cadmium was detected infrequently at the site. For the pooled data, only 3 out of 35 samples showed measurable levels of cadmium, and none of the samples were above the naturally occurring levels (Table 3-2). The mean and maximum concentrations of cadmium are 0.6 and 2.9 mg/kg, respectively, for the both the pooled data and site-wide data. The corresponding levels for California soils is a mean concentration of 3.5 mg/kg and a maximum concentration of 22 mg/kg, respectively (Dragun and Chiasson, 1991). These results clearly indicate that the levels of cadmium are well within the naturally occurring levels, and does not indicate a source related contribution. However, a single soil sample collected along the railroad track had elevated level of cadmium: 3,500 mg/kg in AA-B4-5 (a deeper soil sample, 5 feet). Occurrence of this high level of cadmium does not appear due to SWMU-related activities because shallow and deep samples (AA-B4-3 and AA-B4-10, respectively) are below detection.

Due to the presence of the elevated level of cadmium in AA-B4-5, additional sampling was conducted as part of the most recent Phase II RFI sampling effort to ascertain whether this level is a hot spot or whether it is an outlier. During the Phase II investigation a boring, AA-B10, was collected adjacent to boring location AA-B4; four samples were collected at varying depths at this location to include 1 foot, 3 feet, 5 feet and 10 feet. The analytical results indicate that cadmium was below detection (with a detection limit of 0.3 mg/kg) in all four samples (AA-B10-1, -3, -5, and -10). Thus, based on the Phase II results, it appears that the elevated cadmium level is an outlier and not related to the site.

Because the DTSC clean closure level of 9 mg/kg, which accounts for the toxicity of the metal, is higher than the site concentrations, cadmium does not require further analysis in the risk assessment. However, cadmium may be associated with the waste streams of the site and, therefore, was evaluated in the risk analysis to further illustrate in a quantitative manner the insignificance of metals on-site versus background concentrations.

3.1.3.4 Remaining COCs

The remaining inorganics analyzed for at the site include barium, total chromium, hexavalent chromium, mercury, selenium, and silver.

Barium

Barium was detected uniformly across the site, with the concentrations representative of naturally occurring levels. Barium was detected in 18 of the 35 samples collected as part of the pooled data, and 28 of the 58 site-wide samples. The mean and maximum concentrations of barium for the pooled data are 59.6 mg/kg and 425 mg/kg, respectively (Table 3-2) and 54.3 mg/kg and 425 mg/kg, respectively for the site-wide data (Table 3-3). The corresponding levels for California soils are a mean of 687 mg/kg and a maximum of 1,500 mg/kg, respectively (Dragun and Chiasson, 1991). These results clearly indicate that barium is well within the naturally occurring levels, and does not indicate a source related contribution. In addition, on-site concentrations are well below the DTSC clean closure level of 5,000 mg/kg. Because barium may be site related, it was further evaluated in the HRA.

Hexavalent Chromium and Total Chromium

Hexavalent chromium is the more toxic form of chromium, however, it was below the detection limit (0.2 mg/kg) in all samples evaluated for the pooled and site-wide data. Because hexavalent chromium was below detection, the total chromium concentrations are most likely to be present in the trivalent form. Total chromium, like barium, was detected uniformly across the site. Total chromium was detected in 34 of the 35 samples collected as part of the pooled data, and 55 of the 56 site-wide samples. The mean and maximum concentrations of total chromium for the pooled data are 18.5 mg/kg and 61.6 mg/kg, respectively (Table 3-2) and 16.2 mg/kg and 61.6 mg/kg, respectively for the site-wide data (Table 3-3). The corresponding levels for California soils are a mean of 118 mg/kg and a maximum of 1,500 mg/kg, respectively (Dragun and Chiasson, 1991). In addition, chromium (trivalent form) is well below the DTSC generic clean closure value of 70,000 mg/kg. Because chromium may be site related, it was included in the HRA.

Mercury

Mercury, another toxic inorganic, was detected in only 3 of the samples for the pooled and site-wide data, with a maximum concentration of 0.2 mg/kg. This concentration of mercury is well below DTSC's generic clean closure value of 21 mg/kg, as well as being representative of the mean concentration of mercury in California soils. However, because mercury may be site related, it was included in the HRA.

Selenium and Silver

As with hexavalent chromium, both selenium and silver were below detection in all soil samples. The detection limits for selenium and silver are 1.0 and 2.0 mg/kg, respectively (Tables 3-2 and 3-3). These detection limits are within the ranges naturally occurring in California soils, and do not indicate a source related contribution.

3.1.3.5 Summary of Background Comparison

Besides two outlier detections of lead and cadmium detected at the site, all eight inorganics at the site were detected at levels within regional background. All of the inorganics were either

below detection or uniformly detected across the site regardless of whether the SWMU managed inorganics wastes (i.e. metals) or not.

Although statistical analysis of on-site and background concentrations of inorganics indicate that on-site concentrations are representative of regional background concentrations rather than associated with site hazardous waste management activities, all inorganics were further evaluated in a quantitative HRA. The purpose of the HRA is to compare the relative risk contribution of regional background to on-site risks associated with potential exposure to these chemicals. This additional analysis was performed to determine if some or all of the inorganic COCs can be eliminated from further corrective action consideration.

The risk evaluation included evaluating future industrial (worker) and residential exposure to residual levels of inorganics at the site as well as the risks associated with background concentrations.

Inorganics detected below the detection limit are assumed to be present at the site at half of the detection limit. According to risk assessment guidance, this assumption provides a conservative (protective of human health) estimate of the potential exposure concentrations at the site.

3.2 EXPOSURE ANALYSIS

The exposure analysis is the cornerstone of the HRA. The purpose of this element is to identify and characterize receptor populations, including potentially sensitive subpopulations such as children; identify existing and probable future exposure pathways; and estimate exposure (intake) for each significant subpopulation and pathway based on Reasonable Maximum Exposure (RME) scenarios.

3.2.1 Exposure Pathways

For an exposure pathway to be complete, the following four elements must be present:

1. A source or a release from a source,
2. A probable environmental migration pathway of a site-related chemical (i.e., leaching, volatilization, etc.),
3. An exposure point where receptors may come into contact with the site-related chemical, and
4. A route by which potential receptors may intake a site-related chemical (i.e., ingestion, dermal absorption).

Screening exposure pathways eliminates from consideration those pathways for which there is no potential for exposure to a contaminated medium or for which there is a low potential for contact with human or nonhuman receptors. Based on a screening for this site, the potential exposure pathways associated with site soil are to future human receptors, as there are no current human exposures to soil because all soil is covered by a cap (i.e., pavement or asphalt). In the event that excavation were to occur during re-development of this area, potential exposure may occur to a worker conducting excavation activities on or near exposed soils. In addition, future residential exposure may occur in the event the area is developed into a residential area. Thus, the preliminary list of completed future exposure pathways included for the screening level risk evaluation include:

- Potential future worker exposure
 - incidental ingestion of soil
 - dermal absorption of soil
 - inhalation of airborne particulates
 - ingestion of groundwater affected by soil constituents
- Potential future residential exposure
 - incidental ingestion of soil
 - dermal absorption of soil
 - inhalation of airborne particulates
 - ingestion of groundwater affected by soil constituents

Although no existing or potential beneficial uses of groundwater production wells occur in the area (ESE, 1993), the groundwater exposure pathway is included as a future exposure pathway

in the event that wells are installed for potable purposes. Groundwater could be a possible reservoir for contamination as a result of soil contaminants migrating to groundwater; however, this exposure pathway cannot be quantitatively evaluated because analytical data are not available.

The inhalation exposure pathway was eliminated from further quantitative risk analysis, as this pathway does not contribute significantly to the overall exposure to soil. This is illustrated by the relative contribution of the inhalation exposure route to the total soil exposure scenario (See Appendix E). Removing the inhalation component in the risk or hazard analyses equation does not change the overall risk by an order of magnitude. As shown in Appendix E, inhalation exposure to soil contaminants contributes approximately 9 percent (1.4×10^{-6}) of the total site risk (1.6×10^{-5}) and 7 percent (0.017) of the total site HI (0.26). Therefore, the HRA quantifies site risk based on the oral and dermal routes of exposure.

Although cadmium is carcinogenic via the inhalation route of exposure, 52 out of the 56 site-wide samples were below detection. Only 4 samples contained detectable levels at concentrations slightly higher than the detection limit, (maximum concentration 2.9 mg/kg). Based on these results and the illustration presented in Appendix E, the inhalation exposure pathway to airborne cadmium entrained in dust is expected to contribute insignificantly to the overall health risk, and thus, this pathway was excluded for further quantification in the risk analysis.

3.2.2 Quantification of Exposure

Once the potential exposure pathways have been identified, chemical intakes (the amount of the chemical entering the receptor's body) are calculated. To estimate a RME, the mean and maximum chemical concentrations were used with upperbound (90th or 95th percentile upper confidence limit [UCL_{90} or UCL_{95}] on the arithmetic average) exposure factors to provide a range of risk at the site. Generic intake estimation algorithm can be presented as:

$$I = \frac{C \times CR \times ED \times EF}{BW \times AT}$$

Where:

- I = Intake or Dose, the amount of chemical at the exchange boundary (mg/kg/day).
- C = Chemical concentration, concentration contacted over the exposure period (e.g. mg/kg for soil).
- CR = Contact rate, amount of contaminated medium contacted per unit time or event (e.g., kg/day for soil).
- ED = Exposure duration, describes how long exposure occurs (years).
- EF = Exposure frequency, describes how often exposure occurs (days/year).
- BW = Body weight, average body weight over the exposure period (kg).
- AT = Averaging time, period over which exposure is averaged (ED x days/year for noncarcinogens and 70 x 365 days/year for potential carcinogens).

3.2.2.1 Dermal Exposure to Soil

$$\text{Intake (mg/kg/day)} = \frac{CSo \times FC \times SA \times AF \times ABS \times EF_{so} \times ED}{BW \times AT}$$

Where:

- CSo = chemical concentration in soil (mg/kg).
- FC = conversion factor for soil (kg/mg).
- SA = skin surface area available for soil contact (cm²/event).
- AF = soil to skin adherence factor (mg/cm²).
- ABS = chemical-specific absorption factor (unitless).
- EF_{so} = exposure frequency for soil (events/year).
- ED = exposure duration (years).
- BW = body weight (kg).
- AT = period of time over which exposure is averaged (days).

EPA is currently developing a new methodology using a soil permeability coefficient in place of ABS. However, according to USEPA (1992), "...since these procedures are not

as well developed, it is currently recommended that the users first consider the ABS procedures for estimating dose."

For lifetime dermal exposure:

$$Intake (mg/kg/day) = Y_c \times \sum_{i=1}^2 \frac{SAs_i \times EF_i \times ED_i}{BW_i}$$

Where:

- Y_c = $CS_o \times FC \times AF \times ABS / AT$.
 SAs_i = skin surface area available for soil contact (cm²/event; age-dependent; DTSC, 1994).
 ED_i = exposure duration (years; age range for particular ingestion rate; USEPA, 1991b).
 EF_i = exposure frequency (days; age-dependent; DTSC, 1993b).
 BW_i = body weight (kg; age-dependent; USEPA, 1989).

i	<u>SAs</u>	<u>ED</u>	<u>EF</u>	<u>BW</u>
1	2000	6	350	15
2	5800	24	100	70

3.2.2.2 Oral Exposure to Soil

For adult and child exposures:

$$Intake (mg/kg/day) = \frac{CS_o \times IR_{so} \times FC \times FI \times EF_{so} \times ED}{BW \times AT}$$

Where:

- CS_o = chemical concentration in soil (mg/kg).
 IR_{so} = soil ingestion rate (mg/day).
 FC = conversion factor for soil (kg/mg).
 FI = fraction of soil ingested from contaminated source (unitless).
 EF_{so} = exposure frequency for soil (days/year).

ED = exposure duration (years).
 BW = body weight (kg).
 AT = averaging time (days).

For lifetime exposure (derived from USEPA, 1991a; Incidental Ingestion of Soil and Dust)

$$Intake (mg/kg/day) = Y_c \times \sum_{i=1}^2 \frac{IRs_i \times ED_i}{BW_i}$$

Where:

Y_c = CSo x FC x FI x EFso / AT.
 IRs_i = soil ingestion rate (mg/day; age-dependent; USEPA, 1991b).
 ED_i = exposure duration (years; age range for particular ingestion rate; USEPA, 1991b).
 BW_i = body weight (kg; age-dependent; USEPA, 1989).

<u>i</u>	<u>IRs</u>	<u>ED</u>	<u>BW</u>
1	200	6	15
2	100	24	70

3.3 TOXICITY ASSESSMENT

The toxicity assessment, also referred to as dose-response assessment, weighs the available evidence regarding the potential for a particular chemical to cause adverse effects in exposed individuals and to provide the quantitative nature of the relationship between received dose and biological response. It includes exposure intensity and modifiers of response such as age, sex, route, species and exposure pattern.

The toxicity assessment describes the potential harmful effects of chemicals identified at a site. Based on experimental evidence and/or historical consequences of exposure to a chemical, the chemical is classified as either a carcinogen, or a non-carcinogen. USEPA further classifies carcinogens into groups A through E based on the weight of evidence (WoE) of the chemical

to cause human cancer. Table 3-5 presents the inorganic chemicals detected at the site and their carcinogenic and noncarcinogenic toxicity factors and the associated uncertainty factors (UF) and WoE category. The WoEs are described in Table 3-6.

3.3.1 Toxicity Information for Noncarcinogenic Effects

A reference dose, or RfD, is the toxicity value used most often to evaluate the systemic or noncarcinogenic impacts from exposure to a contaminant. The RfD is the dose to which an individual can be exposed to for lifetime without significant adverse effects. RfDs are specific to the route of exposure (an oral RfD is used to evaluate oral exposure), critical effect (developmental or systemic, etc) and the length of exposure evaluated. For inhalation, reference concentrations (RfCs; mg/m³) are developed for many chemicals and are available in IRIS (EPA, 1994). Since exposure to environmental chemicals are evaluated by determining the dose to which a receptor is exposed, RfCs are converted to RfDs (some are available in USEPA, 1993a) using the following formula, which assumes that a healthy 70-kilogram adult inhales 20 m³/day of air:

$$RfD_i \text{ (mg/kg/day)} = RfC \text{ (mg/m}^3\text{)} \times \frac{20 \text{ (m}^3\text{/day)}}{70 \text{ (kg)}}$$

A chronic RfD is defined as an estimate of a daily intake that is likely to be without appreciable risk of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective against long-term exposure to a chemical. Sub-chronic RfDs are developed to characterize potential noncarcinogenic effects associated with shorter-term exposures. The derivation procedure for RfDs can be found in RAGS (EPA, 1989) or other technical guidance documents for criteria development. The noncarcinogenic COCs detected at the site include:

Oral	Inhalation
Barium	Barium
Cadmium	Trivalent chromium
Trivalent chromium	Mercury

Oral	Inhalation
Mercury	Selenium
Selenium	Silver
Silver	

3.3.2 Toxicity Information for Carcinogenic Effects

A slope factor and the accompanying WoE determination are the toxicity data most commonly used to evaluate potential human carcinogenic risks. For carcinogens USEPA assumes a 'non-threshold' response, which means at every dose level of a carcinogen there is some potential risk of adverse response (cancer). That is, no dose is thought to be risk-free. For carcinogens, USEPA uses a two-part evaluation, first the substance is assigned a WoE classification, and then a slope factor is calculated.

Generally, a slope factor is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over lifetime. Toxicity to carcinogens can be expressed in several ways. The slope factor is usually the 95th percentile confidence limit of the slope of the dose-response curve and is expressed as (mg/kg/day)⁻¹. Toxicity values for carcinogenic effects can also be expressed in terms of risk per unit concentration of the substance in the medium of exposure, called unit risk. The potential carcinogenic inorganic COCs identified include:

Oral	Inhalation
Arsenic	Arsenic
Lead	Cadmium
	Lead

The dose-response values used in the HRA were obtained from USEPA sources such as the Integrated Risk Information System (EPA, 1994), the Health Effects Assessment Summary Tables (EPA, 1993a), as well as from DTSC. The values were used for comparison with the

estimated dose from the site-specific chemical concentrations. The USEPA toxicological databases which are updated on a daily basis, provide toxicological information to include: the physicochemical properties of the chemical, its toxicity and the studies used to develop the toxicity criteria along with various exposure standards available in the literature.

In the absence of readily available RfD or Carcinogenic Slope Factor values (CSF), such values can be developed using the available scientific information and following the procedures described in the guidance manuals. The uncertainty associated with the RfD and CSF values, uncertainty and modification factors used for all the COCs are discussed as part of the toxicity assessment for proper evaluation of the reported outcome. Except for lead, USEPA-verified RfDs and CSFs are available for all the COCs identified at the site. For lead, the LeadSpread developed by the DTSC was used to evaluate lead health risks.

3.4 RISK CHARACTERIZATION

3.4.1 Methods for Evaluating Carcinogenic Risk

Incidental human health risks associated with exposure to carcinogenic contaminants were calculated based on DTSC and USEPA risk assessment guidance. Carcinogenic risk is the intake value or dose (I) multiplied by the CSF.

$$\text{Risk} = I \times \text{CSF}$$

Where:

Risk = Probability for an individual developing cancer, under the assumed exposure conditions,

I = daily chemical intake averaged over a lifetime, and

CSF = carcinogenic slope factor, expressed in (mg/kg/day)⁻¹

The combined risk from exposure to multiple chemicals at a site are evaluated by addition of resultant risks from different chemicals.

$$\text{Risk}_T = \sum \text{Risk}_i$$

Where:

Risk_T = The sum of individual chemical risks, unitless probability

Risk_i = The risk estimate for the i^{th} chemical

Risks were also added across the pathways, if the exposure is to the same individual receptor (eg. a person working with the soil on site, could be exposed by oral and dermal exposure routes, hence the pathways are additive), and if the target organs for toxicity is the same, to obtain the total risk to the receptor.

Risk from exposure to soil =

$$\text{Risk}_{(\text{exposure pathway1})} + \text{Risk}_{(\text{exposure pathway2})} + \text{Risk}_{(\text{exposure pathway3})} + \dots + \text{Risk}_{(\text{exposure pathwayi})}$$

Using the oral CSF to evaluate dermal exposure results in a high degree of uncertainty. However, in most cases and particularly with metals, using the oral CSF with a dermal intake will result in a conservative (to be protective of public health) risk estimate, since the oral value assumes 100 percent absorption and the actual dermal RfD would consider a reduced absorption through a barrier (i.e., skin).

The potential risks resulting from exposure to the site contaminants will be compared with the acceptable risk levels. Acceptable exposure levels are the contaminant concentration levels that present an excess cancer risk of 1 in a million (10^{-6}) for exposure to a single contaminant and 1 to 100 in a million (10^{-6} to 10^{-4}) for exposures to a chemical mixture (EPA, 1991a). The individual risks from the carcinogenic contaminants at the site are compared with 1 in a million risk level, while the cumulative risks as a result of exposure to the entire chemical mixture is compared to the 10^{-6} to 10^{-4} risk range. An exceedance of the individual risk level indicates that the chemical contributes significantly to the overall site risk, while the exceedance of the cumulative risk level indicates that remediation of the medium of concern may be required.

Because this HRA only addresses risks associated with inorganics in soil, these risks are not representative of site-wide risks, rather, they are only one component of the overall site risks. True site-wide risks associated with residual contamination at the site are determined by evaluating all detected chemicals in all media and adding risks across all relevant exposure pathways. Thus, the risks evaluated in this HRA must be considered in future studies when other media are evaluated to provide a true representation of overall site-wide risks associated with the universe of contaminants identified at the site.

3.4.2 Methods for Calculating Noncarcinogenic Hazard Indices

The overall noncarcinogenic effects posed by a chemical at a site is evaluated by assessing the hazard quotient (HQ). A HQ is the ratio of chronic daily intake or dose of the site contaminant and the chronic RfD of the contaminant. The impact from the presence of multiple chemicals at the site is considered additive of impacts from individual contaminants (sum of the HQs) and is called the hazard index (HI).

$$HI = \frac{I_1}{RfD_1} + \frac{I_2}{RfD_2} + \dots + \frac{I_i}{RfD_i}$$

Where:

I_i = Intake for the i^{th} toxicant, and
RfD = Reference dose for the i^{th} toxicant.

I and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or shorter term). When the HI exceeds unity, there may be concern for potential health effects. While any single chemical with an exposure level greater than the toxicity value will cause the HI to exceed unity, for multiple chemicals the HI can also exceed unity due to additivity of multiple chemical HQs.

An HQ below one indicates that it is extremely unlikely that a toxic effect would occur as a result of exposure, while an HQ above one indicates an unacceptable probability of a toxic effect. For this screening level risk assessment, HIs were calculated (using the formulas

presented in Sections 3.2.1.1 and 3.2.1.2 and the appropriate exposure parameters from Table 3-4) for the most conservative residential receptor, a child, as well as for an adult worker.

Using the oral RfD to evaluate dermal exposure results in a high degree of uncertainty. However, in most cases and particularly with metals, using the oral RfD with a dermal intake will result in a conservative (to be protective of public health) hazard estimate, since the oral value assumes 100 percent absorption and the actual dermal RfD would consider a reduced absorption through a barrier (i.e., skin).

3.4.3 Summary of the Risk Characterization

Due to the limited number of samples collected at each SWMU as well as the uniform distribution of detected levels of inorganics across the site, risks and HIs were calculated using the pooled data as well as the site data. Risks and HIs were also calculated for the background concentrations of inorganics in California to provide as a point of comparison and to further illustrate that the inorganics present at the site are representative of background.

3.4.3.1 Risks and HIs

A summary of the cumulative risks and HIs associated with future residential and industrial exposure are shown in Table 3-7. The risks associated with lead are addressed separately, as lead risks are quantified using different methods than the standard USEPA risk methods. Details of the chemical-specific risks contributing to the total risks are in Appendix C and include:

- Theoretical residential exposure to mean (C-1) and maximum (C-2) inorganic concentrations in background soil.
- Worker exposure to mean (C-3) and maximum (C-4) inorganic concentrations in background soil.
- Theoretical residential exposure to mean (C-5) and maximum (C-6) inorganic concentrations in soils for the pooled data (SWMUs Nos. 1, 3, 4, 5, 8, and 11).
- Worker exposure to mean (C-7) and maximum (C-8) inorganic concentrations in soils for the pooled data.
- Theoretical residential exposure to mean (C-9) and maximum (C-10) inorganic concentrations in soils for site-wide data (all SWMUs).

- Worker exposure to mean (C-11) and maximum (C-12) inorganic concentrations in soils for the site-wide data.

Background HI and Risks

The cumulative HI and risk associated with future residential and worker exposure to mean and maximum exposure concentrations of naturally occurring background concentrations of the inorganics analyzed for at the site are presented in Table 3-7. The results of the risk characterization indicate that the mean naturally occurring background concentrations of inorganics are below the cumulative target HI of 1 and risk of 1×10^{-4} , assuming a residential scenario, however, the maximum concentrations exceed both the target HI and risk. The cumulative HI is 4.52 and the risk is 2.6×10^{-4} .

Pooled Data HI and Risks

The results of the risk analysis of the pooled data indicate that all HIs and risks are below the levels of risk posed by natural background conditions for both future residential and worker exposure scenarios. All cumulative HIs were below 1, and the cumulative risks were within the acceptable risk range of 1×10^{-4} to 1×10^{-6} .

Site-wide Data HI and Risks

The results of the site-wide risk analysis indicate that all HIs and risks are below the levels of risk posed by natural background conditions. The HI associated residential exposure to the maximum concentrations slightly exceeds 1, however, this is lower than the HI posed by the maximum concentrations in naturally occurring background levels (HI = 4.52). All the cumulative risks were within the acceptable risk range of 1×10^{-4} to 1×10^{-6} .

3.4.3.2 Risks Associated with Lead Exposure

Based on the lead spreadsheet model developed by the DTSC (1993; Appendix D), 320 mg/kg for lead in residential soils is estimated to be protective of a child. At the 99% confidence level, 320 mg/kg of lead in soil would result in a blood lead level $10 \mu\text{g/dl}$, assuming total exposure includes groundwater and airborne exposure to lead. Although a cleanup value of 320 mg/kg

is protective of a residential child assuming the standard default exposure factors provided by DTSC, such a receptor exposure is not applicable to the site at the present time. In addition, the 320 mg/kg is based on the assumption that the child is also exposed to lead in groundwater and air (0.04 $\mu\text{g}/\text{m}^3$ lead in air; 15 $\mu\text{g}/\text{L}$ lead in groundwater, 0 for plant uptake; and 50 $\mu\text{g}/\text{m}^3$ for airborne dust). Lead was detected uniformly across the site at concentrations below 320 mg/kg, as well as within naturally occurring levels.

Based on a future worker exposure scenario, 3,600 mg/kg would be protective of an adult worker based on DTSC's Lead Spreadsheet Model default exposure assumptions used for a residential adult, (0.04 $\mu\text{g}/\text{m}^3$ lead in air; 15 $\mu\text{g}/\text{L}$ lead in groundwater, 0 for plant uptake; and 50 $\mu\text{g}/\text{m}^3$ for airborne dust). As with the child exposure, the 3,600 mg/kg level is derived assuming that the adult worker is also exposed to lead in groundwater and air (0.04 $\mu\text{g}/\text{m}^3$ lead in air; 15 $\mu\text{g}/\text{L}$ lead in groundwater, 0 for plant uptake; and 50 $\mu\text{g}/\text{m}^3$ for airborne dust). Based on experience with state regulated Superfund sites, however, Cal-EPA recommends a more conservative value of 1,000 mg/kg over the estimated 3,600 mg/kg for the worker, in the event the worker is involved with heavy physical activities such as excavations (Appendix D).

3.5 UNCERTAINTY ANALYSIS

Risk estimates are not full probability estimates of risk, but are conditional estimates given that a set of assumptions concerning exposure and toxicity are realized. Therefore, to place the risk estimates in proper perspective, it is important to fully specify the assumptions and uncertainties inherent in the HRA (EPA, 1989).

According to RAGS (EPA, 1989), qualitative/semi-quantitative uncertainty analysis of each HRA component is sufficient for most sites. Table 3-8 presents the potential uncertainties inherent in the HRA process. A site-specific discussion of these individual components is presented in the following sections.

3.5.1 Hazard Identification

There is a possibility that a chemical or a toxic metabolite was not identified through the

sampling and analytical process or that the results are not an accurate representation of the concentrations that occur on-site. However, this uncertainty is greatly reduced by including all positively detected chemicals in the exposure and risk analysis, as is the case for this evaluation. Inclusion of all inorganic contaminants detected ensures that a conservative estimate of all potential impacts is presented.

3.5.2 Exposure Assessment

Considerable uncertainty is associated with the quantification of exposure. First, use of maximum detected chemical concentrations to represent exposure concentrations may result in overestimates of risk if more than one sample was collected from the area during that time period. Also, the exposure factors used most frequently are default assumptions provided by USEPA or DTSC. When necessary, site-specific information is incorporated to reduce the uncertainty.

The 320 mg/kg and 1,000 mg/kg soil HBRGs for lead concentrations were based on default exposure assumptions which are conservative, as the assumptions include residential exposure conditions to include exposure to all media (dust, soil, and groundwater). If the site related groundwater lead concentrations are lower than the 15 $\mu\text{g/L}$, the calculated lead concentrations are conservative.

3.5.3 Toxicity Assessment

A majority of the uncertainty in an HRA is associated with the use of dose-response data (i.e., to develop RfDs) that have been generated with animals under experimental laboratory conditions and extrapolated to exposure of humans to environmental media. To extrapolate the experimental evidence from animals to humans, a series of uncertainty factors and modifying factors, which have been derived by USEPA, are applied. These uncertainty factors and modifying factors are the quantitative uncertainty associated with the value in question.

As with the noncarcinogenic dose-response assessment, the carcinogenic dose-response assessment includes (1) selection of the appropriate data sets; (2) derivation of estimates at low

doses from experimental data at high doses, using an appropriate extrapolation model (extrapolation is ordinarily carried out first by fitting a mathematical model to the observed data and then by extending the model from the observed range down toward risks expected at low exposure; USEPA, 1994); (3) choice of an equivalent human dose when animal data sets are used; and (4) when only one route has been tested in animals or evaluated in humans, additional assumptions, with corresponding additional uncertainties, may be introduced for route-to-route extrapolation. The level of confidence associated with the CSFs from USEPA can be obtained from the literature from which the dose-response studies for the carcinogenic chemicals were obtained.

Ideally, the calculation of HBRGs should use a route-specific RfD value for oral, dermal, and inhalation exposure routes. Unfortunately the toxicity data necessary for the development of route-specific RfD values are rarely available. The primary concern of using an oral RfD as a surrogate value for the dermal route is that of administered versus absorbed dose. The administered dose, also referred to as the applied dose, is the amount of contaminant given in mg/kg-d that comes into contact with the living tissue of an organism (i.e., applied to the skin; DTSC, 1993b). The absorbed dose is the amount of contaminant that penetrates the exchange boundaries of an organism after contact (DTSC, 1993b). In other words, the applied dose may differ from the dose of contaminant that actually become absorbed into the living tissue. The oral RfD value is almost always based on administered dose, not absorbed dose. Thus, the uncertainty in the application of an oral RfD to the dermal route of exposure could be reduced by adjusting the oral administered dose-RfD to account for bioavailability. An administered-dose ingestion RfD can be converted to an absorbed-dose value by multiplying it by an oral bioavailability factor (BF). However, due to the variability in bioavailability results in a number of chemical-specific studies, BFs were not used in this HRA. As a result, the applied dose is assumed to be equal to the absorbed dose.

3.5.4 Risk Characterization

The uncertainties of the risk characterization include the uncertainties associated with the previous three steps of the HRA process. In most cases, the uncertainties are more than

compensated for by inclusion of upperbound exposure concentrations, upperbound exposure factors, uncertainty factors and modifying factors in developing RfDs and CSFs. Incorporation of the factors and variables to account for uncertainty in each step of the HRA process presents a reasonable upperbound estimate of the potential health risks and hazards. This procedure ensures the protection of public health, because if the upperbound risk estimate represents an acceptable risk, then there is a high level of confidence that an adverse impact will not occur.

4.0 DEVELOPING HEALTH-BASED SOIL REMEDIATION GOALS

While the risk characterization indicates that on-site inorganic concentrations are representative of regional background, clean closure levels were developed based on USEPA and DTSC guidance, to further illustrate that remediation to health-based remediation goals (HBRGs) is inappropriate, as site concentrations of inorganics are representative of background, and background concentrations are higher than HBRGs.

Development of HBRGs were based on (1) the results of the background soil concentration evaluation, (2) methods presented in USEPA and California risk assessment guidance, and (3) future site landuse conditions. The applicable exposure pathways and exposure assumptions and calculations of alternative cleanup levels are presented as follows.

4.1 CALCULATION OF HBRGs

HBRGs are the highest chemical-specific concentrations that do not pose unacceptable health risks and are derived based on the type of contaminant and the type of exposure expected to occur at a site. Thus, in the absence of promulgated standards, HBRGs serve as guidance to determine the necessary level of cleanup at a site that is protective of human health. This evaluation determines HBRGs for the inorganics detected in soil based on direct dermal contact and incidental ingestion of soils for the following two receptor populations:

- ▶ **Residential** – For purposes of clean closure and altered land use, HBRGs are developed assuming future residential exposure to soil.
- ▶ **Commercial/Industrial** – Because the AlliedSignal Solvent Center facility is located in an area zoned for manufacturing-small industry, worker exposure to site soils is also evaluated.

HBRGs are calculated for the inorganics in soil based on the total risk/hazard from all exposure pathways (dermal and incidental oral). The exposure formulas incorporated in the HBRG

calculations are based on the formulas presented in RAGS (EPA, 1989) and the Preliminary Endangerment Assessment Guidance Manual (PEA; DTSC, 1994). Identifiers have been added to the basic exposure factor abbreviations to differentiate those factors that may be used in multiple formulas.

(1) Carcinogenic Risk from Dermal Intake of Soil

$$Risk_{dermal} = \frac{CSF_o \times C_s \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT} \quad (\text{Eq. 1})$$

Where:

- $Risk_{dermal}$ = cancer risk from dermal intake of soil (unitless).
- CSF_o = oral cancer slope factor $[(\text{mg/kg/day})^{-1}]$.
- C_s = chemical concentration in soil (mg/kg).
- SA = skin surface area available for soil contact (cm^2/event).
- AF = soil to skin adherence factor (mg/cm^2).
- ABS = chemical-specific absorption factor (unitless).
- EF = exposure frequency for soil (events/year).
- ED = exposure duration (years).
- FC = conversion factor for soil (kg/mg).
- BW = body weight (kg).
- AT = period of time over which exposure is averaged (days).

EPA is currently developing a new methodology using a soil permeability coefficient in place of ABS. However, according to USEPA (1992), "...since these procedures are not as well developed, it is currently recommended that the users first consider the ABS procedures for estimating dose." This formula is also used in the PEA (DTSC, 1994).

As discussed in Section 3.5.3, using the oral CSF to evaluate dermal exposure results in a high degree of uncertainty. However, in most cases and particularly with metals, using the oral CSF with a dermal intake will result in a conservative (to be protective of public health) hazard estimate, since the oral value assumes 100 percent absorption and the actual dermal RfD would

consider a reduced absorption through a barrier (i.e., skin).

(2) Carcinogenic Risk from Oral Intake of Soil

$$Risk_{oral} = \frac{CSF_o \times C_s \times IR \times EF \times ED \times CF}{BW \times AT} \quad (\text{Eq. 2})$$

Where:

$Risk_{oral}$ = cancer risk from oral intake of soil (unitless).

IR = intake rate for soil (kg/day).

(3) Hazard Index from Dermal Intake of Soil

$$HI_{dermal} = \frac{C_s \times SA \times AF \times ABS \times EF \times ED \times CF}{RfD_o \times BW \times AT} \quad (\text{Eq. 3})$$

Where:

HI_{dermal} = hazard index from dermal intake of soil (unitless).

RfD_o = reference dose (mg/kg/day).

As discussed with respect to Equation 1, although USEPA is currently developing a new methodology for dermal soil evaluation, USEPA (1992) and DTSC (1994) recommend using Equations 1 and 3 to evaluate dermal exposure to soil.

As discussed in Section 3.5.3, using the oral RfD to evaluate dermal exposure results in a high degree of uncertainty. However, in most cases and particularly with metals, using the oral RfD with a dermal intake will result in a conservative (to be protective of public health) hazard estimate, since the oral value assumes 100 percent absorption and the actual dermal RfD would consider a reduced absorption through a barrier (i.e., skin).

(4) Hazard Index from Oral Intake of Soil

$$HI_{oral} = \frac{C_s \times IR \times EF \times ED \times CF}{RfD_o \times BW \times AT} \quad (\text{Eq. 4})$$

Where:

HI_{oral} = hazard index from oral intake of soil (unitless).

4.2 HBRGS FOR FUTURE RESIDENTIAL USE OF THE SITE

Sections 4.1.2.1 and 4.1.2.2 present sample calculations for developing carcinogenic and noncarcinogenic HBRGs, respectively, for residential exposure to inorganic chemicals. Arsenic will be used as an example inorganic. Residential carcinogenic and noncarcinogenic HBRGs for all detected inorganics are developed in Table 3-9.

4.2.1 Carcinogenic HBRGs

Residential carcinogenic HBRGs are based on lifetime exposure (aged 1 through 30, inclusive). Because children and adults exhibit vastly different behavioral patterns, carcinogenic HBRG calculations must include child and adult components. Therefore, separating Equations 1 and 2 to account for child and adult exposures, the lifetime residential risk from dermal and incidental oral contact with site soils can be expressed as follows:

$$\begin{aligned} Risk_{soil} = & CSF_o \times C_s \times \frac{SA_{child} \times AF \times ABS \times EF_{child} \times ED_{child} \times CF}{BW_{child} \times AT_{carc}} \quad (\text{Eq. 5}) \\ & + CSF_o \times C_s \times \frac{SA_{adult} \times AF \times ABS \times EF_{adult} \times ED_{adult} \times CF}{BW_{adult} \times AT_{carc}} \\ & + CSF_o \times C_s \times \frac{IR_{child} \times EF \times ED_{child} \times CF}{BW_{child} \times AT_{carc}} \end{aligned}$$

$$+ CSF_o \times C_s \times \frac{IR_{adult} \times EF \times ED_{adult} \times CF}{BW_{adult} \times AT_{carc}}$$

Replacing the nonchemical-specific exposure parameters in Equation 5 with their respective values (Table 3-3) and solving for concentration (C_s) yields the following equation for calculating residential carcinogenic HBRGs:

$$C_s = \frac{Risk_{soil}}{CSF_o \times [(1.88E-5 \times ABS) + 1.57E-6]} \quad (Eq. 6)$$

Arsenic is classified by the USEPA as a Group A human carcinogen via ingestion and inhalation. Substituting CSF_o and ABS from Tables 3-5 and 3-4, respectively, and using a $Risk_{soil}$ of 1E-6, a residential carcinogenic HBRG of 0.3 mg/kg arsenic is developed.

4.2.2 Noncarcinogenic HBRGs

Residential noncarcinogenic HBRGs are based on child exposure (aged 1 through 6, inclusive) because child exposure results in a more conservative estimate of risk than adult exposure and children are a sensitive subpopulation for many chemicals. Therefore, using a child exposure scenario, the residential noncarcinogenic hazard from dermal and incidental oral contact with site soils can be expressed as follows:

$$HI_{soil} = \frac{C_s}{RfD_o} \times \frac{SA_{child} \times AF \times ABS \times EF_{child} \times ED_{child} \times CF}{BW_{child} \times AT_{noncarc}} + \frac{C_s}{RfD_o} \times \frac{IR_{child} \times EF \times ED_{child} \times CF}{BW_{child} \times AT_{noncarc}} \quad (Eq. 7)$$

Replacing the nonchemical-specific exposure parameters in Equation 3-7 with their respective values from Table 3-4 and solving for concentration (C_s) yields the following equation for calculating residential noncarcinogenic HBRGs:

$$C_s = \frac{HI_{soil} \times RfD_o}{(1.28E-4 \times ABS) + 1.28E-5} \quad (\text{Eq. 8})$$

Substituting RfD_o and ABS from Tables 3-5 and 3-4, respectively, and using an HI_{soil} of 1, a residential noncarcinogenic HBRG for arsenic of 18 mg/kg is developed (Table 3-9).

4.3 HBRGS FOR FUTURE COMMERCIAL/INDUSTRIAL USE OF THE SITE

Sections 4.1.3.1 and 4.1.3.2 present sample calculations for developing carcinogenic and noncarcinogenic HBRGs, respectively, for worker exposure to inorganic chemicals. As in Section 4.1.2, arsenic will be used as an example inorganic. Worker carcinogenic and noncarcinogenic HBRGs for all detected inorganics are developed in Table 3-9.

4.3.1 Carcinogenic HBRGs

Worker carcinogenic HBRGs are based on a work lifetime exposure of 25 years. Adapting Equation 5 for a worker, the worker carcinogenic risk from dermal and incidental oral contact with site soils can be expressed as follows:

$$\begin{aligned} Risk_{soil} = & CSF_o \times C_s \times \frac{SA_{adult} \times AF \times ABS \times EF_{worker} \times ED_{worker} \times CF}{BW_{adult} \times AT_{carc}} \\ & + CSF_o \times C_s \times \frac{IR_{worker} \times EF_{worker} \times ED_{worker} \times CF}{BW_{adult} \times AT_{carc}} \end{aligned} \quad (\text{Eq. 9})$$

Replacing the nonchemical-specific exposure parameters in Equation 9 with their respective values (Table 3-4) and solving for concentration (C_s) yields the following equation for calculating worker carcinogenic HBRGs:

$$C_s = \frac{Risk_{soil}}{CSF_o \times [(2.03E-5 \times ABS) + 1.75E-7]} \quad (\text{Eq. 10})$$

Substituting CSF_o and ABS from Tables 3-5 and 3-4, respectively, and using a $Risk_{soil}$ of $1E-6$, a worker carcinogenic HBRG of 0.7 mg/kg arsenic is developed (Table 3-9).

4.3.2 Noncarcinogenic HBRGs

Similar to worker carcinogenic HBRGs, worker noncarcinogenic HBRGs are based on a work lifetime exposure of 25 years. Adapting Equation 7 for a worker, the worker noncarcinogenic hazard from dermal and incidental oral contact with site soils can be expressed as follows:

$$HI_{soil} = \frac{C_s}{RfD_o} \times \frac{SA_{adult} \times AF \times ABS \times EF_{worker} \times ED_{worker} \times CF}{BW_{adult} \times AT_{noncarc}} \quad (\text{Eq. 11})$$

$$+ \frac{C_s}{RfD_o} \times \frac{IR_{worker} \times EF_{worker} \times ED_{worker} \times CF}{BW_{adult} \times AT_{noncarc}}$$

Replacing the nonchemical-specific exposure parameters in Equation 11 with their respective values (Table 3-3) and solving for concentration (C_s) yields the following equation for calculating worker noncarcinogenic HBRGs:

$$C_s = \frac{HI_{soil} \times RfD_o}{(5.68E-5 \times ABS) + 4.89E-7} \quad (\text{Eq. 12})$$

Substituting RfD_o and ABS from Tables 3-5 and 3-4, respectively, and using an HI_{soil} of 1, a worker noncarcinogenic HBRG for arsenic of 137 mg/kg is developed.

HBRGs for future residential and worker exposure to inorganics in soil developed in the preceding Sections 4.1.2 and 4.1.3 are summarized in Table 3-9.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The background evaluation, risk analysis, and HBRG evaluation indicate that the concentrations of inorganics detected across the site are not associated with site operations, rather the concentrations are representative of naturally occurring background levels.

Barium, cadmium, chromium, mercury, selenium, and silver are not only representative of background, they also pose HIs and risks below background levels and were within the acceptable ranges. These six analytes were also present at the site below the HBRGs developed for future residential and worker exposure based on USEPA and Cal-EPA guidance, and DTSC Generic Clean Closure Levels (DTSC, 1992) indicating that remediation of these six inorganics is not required (Table 3-10).

Arsenic, lead, and cadmium were determined to be representative of background and pose HIs and risks below background levels. Arsenic is present at the site above the HBRGs developed for future residential and worker exposure. However, background concentrations of arsenic exceed HBRGs more than site concentrations of arsenic, indicating remediation of arsenic is not required (Table 3-10).

Lead concentrations are representative of site background and are present below the HBRG at locations associated with site operations, indicating that remediation of lead on site is not required (Table 3-10). However, two soil samples collected along the former railroad spur contained elevated levels of lead: 3,720 mg/kg in S9-B3-1 (surficial soil sample, 1 foot) and 5,780 mg/kg in AA-B4-5 (a deeper soil sample, 5 feet). The remaining samples from both borings (AA-B4-2, -3, and -10; S9-B3-5 and -10) were below detection for lead. Phase II sampling confirmed that these concentrations are outliers and not related to SWMU activities.

Cadmium, like lead, was detected at elevated levels in only one sample at a depth of 5 feet. The concentration detected was 3,500 mg/kg (AA-B4-5), while the remaining samples from the boring, collected at depths of 2 feet, 3 feet, and 10 feet were below detection. Occurrence of

this high level of cadmium does not appear due to SWMU-related activities as indicated by the site history, rather this "hot spot" may also be associated with railroad-related activities, possibly from railroad slag. The exact source should be further investigated prior to remediation efforts.

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Table 1-1. Generic Clean Closure Levels for Inorganic Chemicals Present in Soil at the AlliedSignal, Inc. Solvent Center, San Diego, California

Compound	Generic Clean Closure Level (mg/kg) ^{a,b}
Arsenic	0.3
Barium	5,000
Cadmium	9.0
Chromium III	70,000
Chromium VI	0.2
Lead	130
Mercury	21

^aBased on theoretical soil saturation.

^bThese levels can be used provided that there is no potential for groundwater impact.

Source: DTSC, 1993a.

Table 3-1. Waste Streams Associated with Site Operations at the AlliedSignal Solvent Center, San Diego, California

SWMU Name and Number	Treatment, Storage, and Disposal Area/Process	Wastestreams
Hazardous Container Storage Area (1)	Warehouse building housing drums and tote tanks	Halogenated and nonhalogenated spent solvents
Process Still Area (3)	Spent solvent distillation system	Halogenated spent solvents
Wash Water/Storm Water Holding Tank (4)	Neutralization tank to accumulate acid rinse water from the cleaning of acid containers, storm water runoff, and exterior truck wash water.	Acids, Anhydrous ammonia Metals, Halogenated solvents
Container Rinse Area (5)	Concrete pad for rinsing containers containing acidic wastes from plating operations	Acids, Metals
Sump/Drainage Ditch (6)	Concrete sump and ditch for accumulating liquid spills, rinse water (exterior wash of delivery trucks), and storm water	Corrosives, Metals, Virgin halogenated solvents, Virgin nonhalogenated solvents
Empty Container Storage Area (7)	Concrete storage area for empty drums	Virgin and spent halogenated and nonhalogenated solvents, Metals
Shipping and Receiving Area (8)	Concrete and paved area for temporary staging of all materials for the facility.	Virgin and spent halogenated and nonhalogenated solvents, Metals
Old Container Storage Area (9)	Paved area for storage of aged and empty containers.	Acids, Halogenated and nonhalogenated solvents
Old Spent Solvent Distillation System (10)	Still and feed tank to reclaim spent solvents; storage area for drummed virgin chemicals.	Reclaimed spent solvents, Virgin solvents
Old Empty Container Storage Area (11)	Storage area for old empty containers.	Virgin acids and bases, Spent solvents, Spent corrosives (possibly containing metals)

Source: ESE.

TABLE 3-2. Concentrations of Inorganics Detected in Soils (0 - 3 ft depth) at SWMUs Nos. 1, 3, 4, 5, 6, 8 and 11, AlliedSignal Solvent Center, San Diego, California (mg/kg)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Container Storage (#1)	S1-B1-0.5	NA	NA	NA	NA	*0.1	NA	NA	NA	NA
	S1-B1-3	NA	NA	NA	NA	*0.1	NA	NA	NA	NA
Process Still Area (#3)	+	+	+	+	+	+	+	+	+	+
Wash Water/Storm Water Holding Tank (#4)	+	+	+	+	+	+	+	+	+	+
Container Rinse (#5)	S5-B1-1	2.9	59.3	0.5	14	*0.1	69.8	*0.05	*0.5	*1
	S5-B1-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	S5-B2-1	2	40.7	*0.5	61.6	*0.1	34.8	*0.05	*0.5	*1
	S5-B2-3	3.9	93.1	*0.5	19.2	*0.1	15	*0.05	*0.5	*1
	S5-B3-1**	5.9	52.7	*0.5	11.1	*0.1	31	0.15	*0.5	*1
	S5-B3-3**	6.5	50.5	*0.5	11.9	*0.1	29	0.18	*0.5	*1
	S5-B4-1	0.49	*20	*0.5	*1	*0.1	17.8	*0.05	*0.5	*1
	S5-B4-3	1.3	40.7	*0.5	13.9	*0.1	*5	*0.05	*0.5	*1
Sump and Drainage Ditch (#6)	S6-B1-1	0.75	92.5	1.6	36.1	*0.1	23.6	*0.05	*0.5	*1
	S6-B1-3	2	41.2	*0.5	31.6	*0.1	10.5	*0.05	*0.5	*1
	S6-B2-1	0.95	*20	*0.5	14.6	*0.1	*5	*0.05	*0.5	*1
	S6-B2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA

Continued. . .

TABLE 3-2. (Continued)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Sump and Drainage Ditch (#6)	S6-B3-1	2.6	*20	*0.5	12.6	*0.1	*5	*0.05	*0.5	*1
	S6-B3-3	1.3	*20	*0.5	10.1	*0.1	*5	*0.05	*0.5	*1
	S6-B4-1	1.9	*20	*0.5	19	*0.1	*5	*0.05	*0.5	*1
	S6-B4-3	1.9	*20	*0.5	9	*0.1	*5	*0.05	*0.5	*1
	S6-B5-1	8.1	*20	*0.5	55.9	*0.1	*5	*0.05	*0.5	*1
	S6-B5-3	9.3	47.8	*0.5	45.9	*0.1	23.6	*0.05	*0.5	*1
Shipping and Receiving (#8)	S8-B1-1	1.4	*20	*0.5	6.8	*0.1	44.1	*0.05	*0.5	*1
	S8-B1-3	2.3	*20	*0.5	11.9	*0.1	15.8	*0.05	*0.5	*1
	S8-B2-1	1.5	*20	*0.5	7.2	*0.1	11.7	*0.05	*0.5	*1
	S8-B2-3	3.3	*20	1.6	6.8	*0.1	46	0.19	*0.5	*1
	S8-B3-1	2	392	*0.5	4.3	*0.1	20.2	*0.05	*0.5	*1
	S8-B3-3	4.7	*20	*0.5	13.7	*0.1	*5	*0.05	*0.5	*1
	S8-B4-1	5.5	425	*0.5	56.8	*0.1	150	*0.05	*0.5	*1
	S8-B4-3	5.7	43.3	*0.5	24.2	*0.1	31.8	*0.05	*0.5	*1
	S8-B6-1	1.5	46.8	*0.5	9.3	*0.1	37.7	*0.05	*0.5	*1
	S8-B6-3	2.8	*20	*0.5	12.1	*0.1	*5	*0.05	*0.5	*1
	S8-B7-1	2.6	40.7	*0.5	8.7	*0.1	37.9	*0.05	*0.5	*1
	S8-B7-3	2.9	*20	*0.5	13.6	*0.1	*5	*0.05	*0.5	*1

Continued. . .

TABLE 3-2. (Continued)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Old Empty Container Storage Area (#11)	S11-B1-1	2.2	44.4	2.9	18.4	*0.1	15.3	*0.05	*0.5	*1
	S11-B1-3	1.4	*20	*0.5	10.9	*0.1	62.8	*0.05	*0.5	*1
	S11-B2-1	8.8	154	*0.5	4.1	*0.1	*5	*0.05	*0.5	*1
	S11-B2-3	1.3	*20	*0.5	10.4	*0.1	*5	*0.05	*0.5	*1
	S11-B3-1	2.3	40.7	*0.5	18.3	*0.1	17.3	*0.05	*0.5	*1
	S11-B3-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	S11-B4-1	2.2	*20	*0.5	24.2	*0.1	21.4	*0.05	*0.5	*1
	S11-B4-3	2.4	41.9	*0.5	18.3	*0.1	*5	*0.05	*0.5	*1
Site-Wide Statistics	N	35	35	35	35	35	35	35	35	35
	Minimum	0.5	20.0	0.5	1.0	0.1	5.0	0.1	0.5	1.0
	Maximum	9.3	425	2.9	61.6	0.1	150	0.2	0.5	1.0
	Mean	3.1	59.6	0.6	18.5	0.1	23.8	0.1	0.5	1.0
	Std. Deviation	2.3	90.2	0.5	15.0	0	27.4	0.03	0	0
	#NA, NS	4	4	4	3	5	4	4	4	4
	#BDL	0	17	32	1	35	13	32	35	35
Natural Background in Native California Soils (a)	N	72	75	24	75	NA	75	73	73	477 b
	Minimum	0.3	150	0.01	10	NA	BDL	0.01	<0.1	<0.5 b
	Maximum	69	1,500	22	1,500	NA	300	1.5	1.5	5 b

Continued. . .

TABLE 3-2. (Continued)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Natural Background in Native California Soils (a)	Mean	6.6	687	3.5	118	NA	29	0.154	0.29	<0.5 b
	Std. Deviation	8.8	317	4.8	211	NA	41	0.257	0.26	NA b

Notes:

* - half of the detection limit

** - no 0 - 3 foot samples taken beneath SWMU 4, Wash water/storm water holding tank; however, these samples were collected nearby.

+ - samples collected at depths below 3 feet.

-- - not available

N - number of samples

Minimum - minimum detected concentration

Maximum - maximum detected concentration

Mean - mean concentration

Std. Deviation - standard deviation of detection concentrations

BDL - below detection limit, detection limit not reported

NA - not analyzed

NS - not sampled

(a) Dragun, J. and Chiasson, A., 1991.

(b) Western U.S., B-Horizon.

Source: ESE.

TABLE 3-3. Concentrations of Inorganics Detected in Soils (0-3 ft depth) Site-Wide, AlliedSignal Solvent Center, San Diego, California (mg/kg)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Container Storage (#1)	S1-B1-0.5	NA	NA	NA	NA	*0.1	NA	NA	NA	NA
	S1-B1-3	NA	NA	NA	NA	*0.1	NA	NA	NA	NA
Process Still Area (#3)	+	+	+	+	+	+	+	+	+	+
Wash Water/Storm Water Holding Tank (#4)	+	+	+	+	+	+	+	+	+	+
Container Rinse (#5)	S5-B1-1	2.9	59.3	0.5	14	*0.1	69.8	*0.05	*0.5	*1
	S5-B1-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	S5-B2-1	2	40.7	*0.5	61.6	*0.1	34.8	*0.05	*0.5	*1
	S5-B2-3	3.9	93.1	*0.5	19.2	*0.1	15	*0.05	*0.5	*1
	S5-B3-1**	5.9	52.7	*0.5	11.1	*0.1	31	0.15	*0.5	*1
	S5-B3-3**	6.5	50.5	*0.5	11.9	*0.1	29	0.18	*0.5	*1
	S5-B4-1	0.49	*20	*0.5	*1	*0.1	17.8	*0.05	*0.5	*1
	S5-B4-3	1.3	40.7	*0.5	13.9	*0.1	*5	*0.05	*0.5	*1
Sump and Drainage Ditch (#6)	S6-B1-1	0.75	92.5	1.6	36.1	*0.1	23.6	*0.05	*0.5	*1
	S6-B1-3	2	41.2	*0.5	31.6	*0.1	10.5	*0.05	*0.5	*1
	S6-B2-1	0.95	*20	*0.5	14.6	*0.1	*5	*0.05	*0.5	*1
	S6-B2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	S6-B3-1	2.6	*20	*0.5	12.6	*0.1	*5	*0.05	*0.5	*1

Continued. . .

TABLE 3-3. (Continued)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Sump and Drainage Ditch (#6)	S6-B3-3	1.3	*20	*0.5	10.1	*0.1	*5	*0.05	*0.5	*1
	S6-B4-1	1.9	*20	*0.5	19	*0.1	*5	*0.05	*0.5	*1
	S6-B4-3	1.9	*20	*0.5	9	*0.1	*5	*0.05	*0.5	*1
	S6-B5-1	8.1	*20	*0.5	55.9	*0.1	*5	*0.05	*0.5	*1
	S6-B5-3	9.3	47.8	*0.5	45.9	*0.1	23.6	*0.05	*0.5	*1
Empty Drum Storage Area (#7)	S7-B1-1	2.5	49.8	*0.5	12.4	*0.1	15.3	*0.05	*0.5	*1
	S7-B1-3	1.8	*20	*0.5	11.1	*0.1	*5	*0.05	*0.5	*1
	S7-B2-1	2.2	*20	*0.5	10.7	*0.1	*5	*0.05	*0.5	*1
	S7-B2-3	2	*20	*0.5	12	*0.1	*5	*0.05	*0.5	*1
	S7-B3-1	2.3	41.8	*0.5	10.9	*0.1	11	*0.05	*0.5	*1
	S7-B3-3	1.9	*20	*0.5	12.5	*0.1	*5	*0.05	*0.5	*1
Shipping and Receiving (#8)	S8-B1-1	1.4	*20	*0.5	6.8	*0.1	44.1	*0.05	*0.5	*1
	S8-B1-3	2.3	*20	*0.5	11.9	*0.1	15.8	*0.05	*0.5	*1
	S8-B2-1	1.5	*20	*0.5	7.2	*0.1	11.7	*0.05	*0.5	*1
	S8-B2-3	3.3	*20	1.6	6.8	*0.1	46	0.19	*0.5	*1
	S8-B3-1	2	392	*0.5	4.3	*0.1	20.2	*0.05	*0.5	*1
	S8-B3-3	4.7	*20	*0.5	13.7	*0.1	*5	*0.05	*0.5	*1
	S8-B4-1	5.5	425	*0.5	56.8	*0.1	150	*0.05	*0.5	*1

Continued. . .

TABLE 3-3. (Continued)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Shipping and Receiving (#8)	S8-B4-3	5.7	43.3	*0.5	24.2	*0.1	31.8	*0.05	*0.5	*1
	S8-B6-1	1.5	46.8	*0.5	9.3	*0.1	37.7	*0.05	*0.5	*1
	S8-B6-3	2.8	*20	*0.5	12.1	*0.1	*5	*0.05	*0.5	*1
	S8-B7-1	2.6	40.7	*0.5	8.7	*0.1	37.9	*0.05	*0.5	*1
	S8-B7-3	2.9	*20	*0.5	13.6	*0.1	*5	*0.05	*0.5	*1
Old Container Storage Area (#9)	S9-B1-1	NS	NS	NS	NS	NS	NS	NS	NS	NS
	S9-B1-3	2.5	*20	*0.5	10	*0.1	27.5	*0.05	*0.5	*1
	S9-B2-1	2.3	*20	*0.5	9.8	*0.1	*5	*0.05	*0.5	*1
	S9-B2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	S9-B3-1	6	163	*0.5	12.4	*0.1	3,720	*0.05	*0.5	*1
	S9-B3-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Old Spent Solvent Distillation System (#10)	S10-B1-1	3.1	*20	*0.5	12.6	*0.1	*5	*0.05	*0.5	*1
	S10-B1-3	3.2	41.2	1.1	10.8	*0.1	25.6	*0.05	*0.5	*1
	S10-B2-1	3	40.3	*0.5	9.1	*0.1	52	*0.05	*0.5	*1
	S10-B2-3	16.7	*20	*0.5	8.8	*0.1	21.5	*0.05	*0.5	*1
Old Empty Container Storage Area (#11)	S11-B1-1	2.2	44.4	2.9	18.4	*0.1	15.3	*0.05	*0.5	*1
	S11-B1-3	1.4	*20	*0.5	10.9	*0.1	62.8	*0.05	*0.5	*1

Continued. . .

TABLE 3-3. (Continued)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Old Empty Container Storage Area (#11)	S11-B2-1	8.8	154	*0.5	4.1	*0.1	*5	*0.05	*0.5	*1
	S11-B2-3	1.3	*20	*0.5	10.4	*0.1	*5	*0.05	*0.5	*1
	S11-B3-1	2.3	40.7	*0.5	18.3	*0.1	17.3	*0.05	*0.5	*1
	S11-B3-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	S11-B4-1	2.2	*20	*0.5	24.2	*0.1	21.4	*0.05	*0.5	*1
	S11-B4-3	2.4	41.9	*0.5	18.3	*0.1	*5	*0.05	*0.5	*1
Miscellaneous Areas	AA-B1-1	2.6	127	*0.5	18.3	*0.1	12	*0.05	*0.5	*1
	AA-B1-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	AA-B2-1	20.8	48.3	*0.5	7.5	*0.1	13.5	*0.05	*0.5	*1
	AA-B2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
	AA-B3-1	21.3	41.8	*0.5	4.9	*0.1	11.3	*0.05	*0.5	*1
	AA-B3-3	3.4	139	*0.5	16.4	*0.1	*5	*0.05	*0.5	*1
	AA-B4-1	2.1	*20	*0.5	18.2	*0.1	*5	*0.05	*0.5	*1
	AA-B4-3	2.4	*20	*0.5	18.2	*0.1	*5	*0.05	*0.5	*1
	AA-B5-1	3.2	41.1	*0.5	19.6	*0.1	*5	*0.05	*0.5	*1
	AA-B5-3	1.6	*20	*0.5	13.8	*0.1	*5	*0.05	*0.5	*1
Site-Wide Statistics	N	56	56	56	56	56	56	56	56	56
	Minimum	0.5	20.0	0.5	1.0	0.1	5.0	0.1	0.5	1.0
	Maximum	21.3	425	2.9	61.6	0.1	3,720	0.2	0.5	1.0

Continued. . .

TABLE 3-3. (Continued)

SWMU No.	SAMPLE ID	ARSENIC	BARIUM	CADMIUM	TOTAL CHROMIUM	HEXAVALENT CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
Site Statistics	Mean	3.8	54.3	0.6	16.2	0.1	85.7	0.1	0.5	1.0
	Std. Deviation	4.2	76.1	0.4	12.5	0	491	0.03	0	0
	#NA, NS	10	10	10	10	8	10	10	10	10
	#BDL	1	28	52	1	58	24	53	56	56
Natural Background in Native California Soils (a)	N	72	75	24	75	NA	75	73	73	477 b
	Minimum	0.3	150	0.01	10	NA	BDL	0.01	<0.1	<0.5 b
	Maximum	69	1,500	22	1,500	NA	300	1.5	1.5	5 b
	Mean	6.6	687	3.5	118	NA	29	0.154	0.29	<0.5 b
	Std. Deviation	8.8	317	4.8	211	NA	41	0.257	0.26	NA b

NOTES:

- * - half of the detection limit
- ** - no 0 - 3 foot samples taken beneath SWMU 4, Wash water/storm water holding tank; however, these samples were collected nearby.
- + - samples collected at depths below 3 feet.
- - not available
- N - number of samples
- Minimum - minimum detected concentration
- Maximum - maximum detected concentration
- Mean - mean concentration
- Std. Deviation - standard deviation of detection concentrations
- BDL - below detection limit, detection limit not reported
- NA - not analyzed
- NS - not sampled

(a) Dragun, J. and Chiasson, A., 1991.

(b) Western U.S., B-Horizon.

Source: ESE.

Table 3-4. Exposure Parameters

Parameter	Value	Source
Nonchemical-Specific		
AF; soil-to-skin adherence factor	1.0 mg/cm ²	DTSC, 1994
AT; averaging time	carcinogenic - 25,550 days noncarcinogenic - ED x 365 days/year	DTSC, 1994 DTSC, 1994
BW; body weight	adult - 70 kg child - 15 kg	DTSC, 1994 DTSC, 1994
CF; conversion factor	1E-6 kg/mg	DTSC, 1994
ED; exposure duration	adult - 24 years child - 6 years worker - 25 years	DTSC, 1994 DTSC, 1994 EPA, 1991
EF; exposure frequency	adult dermal - 100 days/year adult oral - 350 days/year child dermal - 350 days/year child oral - 350 days/year worker - 250 days/year	DTSC, 1994 DTSC, 1994 DTSC, 1994 DTSC, 1994 EPA, 1991
FI; fraction of soil ingested from contaminated area	1.0 (unitless)	assumed
IR; ingestion rate	adult - 100 mg/day child - 200 mg/day worker - 50 mg/day	DTSC, 1994 DTSC, 1994 EPA, 1991
SA; surface area	adult - 5,800 cm ² child - 2,000 cm ²	DTSC, 1994 DTSC, 1994
Chemical-Specific		
ABS; absorption factor	arsenic - 0.03 cadmium - 0.001 all other metals - 0.01	DTSC, 1994 DTSC, 1994 DTSC, 1994

Source: ESE.

Table 3-5. Chronic Dose-Response Toxicity Constants for Inorganic Chemicals at the AlliedSignal Solvent Center, San Diego, California

Chemical	Oral RfD (UF)*	Inhal RfD (UF)*	Oral CSF*	Oral WoE*	Inhal CSF*	Inhal WoE*
Inorganic Chemicals (IOC)						
Arsenic	3.0E-04 (3)	--	1.8E+00 ¹¹	A	5.0E+01 [#]	A
Barium	7.0E-02 (3)	1.0E-04 (1,000)	--		--	
Cadmium (solid matrix)	1.0E-03 (10)	--	--		6.3E+00 ¹²	B1
Chromium (trivalent)	1.0E+00 (1,000)	--	--		--	
Lead	-- ¹³	--	nd ¹⁴	B2	nd ¹⁴	B2
Mercury	3.0E-04* (1,000)	8.6E-05* (30)	--		--	
Selenium	5.0E-03 (3)	--	--		--	
Silver	5.0E-03 ¹⁵ (3)	--	--		--	

Notes: RfD = reference dose [mg/kg/day].
 UF = uncertainty factor (includes any applicable modifying factor).
 CSF = cancer slope factor [(mg/kg/day)⁻¹].
 WoE = weight of evidence for ranking as a human carcinogen (see Table 3-6).
 inhal = inhalation.
 nd = not determined.

- (11) Oral CSF for arsenic is based on an oral unit cancer risk of $5 \times 10^{-5} (\mu\text{g/L})^{-1}$ proposed by the Risk Assessment Forum (EPA, 1991a).
 (12) Inhalation CSF for cadmium based on an inhalation unit cancer risk of $1.8 \times 10^{-3} (\mu\text{g/m}^3)^{-1}$ and assumes that a healthy 70-kilogram adult inhales 20 m³/day of air.
 (13) EPA prefers to use a biokinetic uptake model to evaluate lead exposure rather than the reference dose method.
 (14) Although USEPA has classified lead as a Group B2 suspect human carcinogen via ingestion and inhalation, no CSF has been developed for either of these exposure pathways.
 (15) RfD for silver based on aesthetic endpoint (argyria).

*All RfDs, CSFs, and WoEs are available in IRIS (1994), unless otherwise noted.

[#]This value is available in HEAST (EPA, 1993).

Source: ESE.

Table 3-6. Weight-of-Evidence Categories for Potential Carcinogens

USEPA Category	Description of Group	Description of Evidence
Group A	Human carcinogen	Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer
Group B1	Probable human carcinogen	Limited evidence of carcinogenicity in humans from epidemiologic studies
Group B2	Probable human carcinogen	Sufficient evidence of carcinogenicity in animals but inadequate data in humans
Group C	Possible human carcinogen	Limited evidence of carcinogenicity in animals
Group D	Not classified	Inadequate evidence of carcinogenicity in animals
Group E	No evidence of carcinogenicity in humans	No evidence of carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies

Source: USEPA, 1986.

TABLE 3-7. Summary of HI and Risk Calculations for Future Residential and Worker Exposure to Concentrations of Inorganics in Soil *

Exposure Concentration	RESIDENTIAL						WORKER					
	HI (a)			Risk (b)			HI (a)			Risk (b)		
	Background	SWMU # 1,4,5,6,8,11	Site-Wide	Background	SWMU # 1,4,5,6,8,11	Site-Wide	Background	SWMU # 1,4,5,6,8,11	Site-Wide	Background	SWMU # 1,4,5,6,8,11	Site-Wide
Mean	0.56	0.20	0.24	2.50E-05	1.20E-05	1.40E-05	0.06	0.02	0.03	9.10E-06	4.30E-06	5.30E-06
Maximum	4.52	0.65	1.32	2.60E-04	3.50E-05	7.90E-05	0.55	0.08	0.17	9.50E-05	1.30E-05	2.90E-05

NOTES:

(a) Total HIs are based on oral and dermal exposure to the following chemicals: arsenic, barium, cadmium, chromium, mercury, selenium and silver (no RD is available for lead).

(b) Total risks are based on oral and dermal exposure to arsenic (no CFM is available for lead).

* HIs and risks are calculated using formulas presented in Sections 3.2 and 3.4. HI and risk calculations are presented in Appendix C.

Source: ESE.

Table 3-8. Uncertainties Associated with the Risk Assessment Process.

RA Component	Potential for:
Hazard Identification	<ul style="list-style-type: none"> · Initial Selection of COCs · Data gaps · Tentatively Identified Compounds · Chemical Monitoring Data
Exposure Assessment	<ul style="list-style-type: none"> · Selection of Site-Specific Exposure Pathways · Likelihood of Exposure Pathways and Land Uses Actually Occurring · Estimation of Exposure Concentrations · Estimation of Exposure to Multiple Substances · Estimation of Intake Parameter
Toxicity Assessment	<ul style="list-style-type: none"> · Selection of Toxicity Values · Factors Used in Derivation of Toxicity Values Including Interspecies Extrapolation · Weight-of-Evidence for Human Toxicity · Derivation of Carcinogenic Slope Factors · Extrapolation of Less-than-lifetime Exposure to Lifetime Cancer Risks · High-to-Low Dose Extrapolation of Toxicity Values · Route-to-Route Application of Dose-response Values · Interaction of Multiple Substances
Risk Characterization	<ul style="list-style-type: none"> · Addition of Risks Across Multiple Exposure Pathways · Addition of Risks from Multiple Substances

Source: ESE.

TABLE 3-9. HBRGs for Future Residential and Worker Exposure to Inorganics in Soil.

Chemical	ABS	Oral CSF (mg/kg/day)-1	Oral RfD (mg/kg/day)	Residential HBRGs (a) (mg/kg)		Commercial HBRGs (a) (mg/kg)	
				Carcinogenic	Noncarcinogenic	Carcinogenic	Noncarcinogenic
Potential Carcinogens							
Arsenic	0.03	1.8E+00	3.0E-04	2.7E-01	1.8E+01	7.3E-01	1.4E+02
Lead	0.01	ND	ND	--	--	--	--
Noncarcinogens							
Barium	0.01	--	7.0E-02	--	5.0E+03	--	6.6E+04
Cadmium	0.001	--	1.0E-03	--	7.7E+01	--	1.8E+03
Chromium (b)	0.01	--	1.0E+01	--	7.1E+05	--	9.5E+06
Mercury	0.01	--	3.0E-04	--	2.1E+01	--	2.8E+02
Selenium	0.01	--	5.0E-03	--	3.6E+02	--	4.7E+03
Silver	0.01	--	5.0E-03	--	3.6E+02	--	4.7E+03

NOTES:

ABS - dermal absorption factor (DTSC, 1993)

CSF - cancer slope factor (DTSC, 1992, USEPA, 1993, 1994)

RfD - reference dose (EPA, 1993, 1994)

(a) Based on risk assessment guidance (DTSC, 1992, 1993; USEPA, 1989)

(b) Based on trivalent chromium, since hexavalent chromium results were below the detection limit

Source: ESE.

TABLE 3-10. Comparison of Site Background to Health-Based Levels (mg/kg)

Potential Cleanup Levels	Arsenic	Barium	Cadmium	Total Chromium	Lead	Mercury	Selenium	Silver
Site Background								
Minimum	0.3	150	0.01	10	BDL	0.01	<0.1	<0.5
Maximum	69	1,500	22	1,500	300	1.5	1.5	5
Mean	6.6	687	3.5	118	29	0.154	0.29	<0.5
SWMU #1,4,5,6,8,11								
Minimum	0.5	20	0.5	1	5.0	0.1	0.5	1.0
Maximum	9.3	425	2.9	61.6	150	0.2	0.5	1.0
Mean	3.1	59.6	0.6	18.5	23.8	0.1	0.5	1.0
Site-wide Statistics								
Minimum	0.5	20	0.5	1	5.0	0.1	0.5	1.0
Maximum	21.3	425	2.9	61.6	3,720	0.2	0.5	1.0
Mean	3.8	54.3	0.6	16.2	85.7	0.1	0.5	1.0
HBRG								
Residential	0.268	4,970	77.4	710,000	*320	21.3	355	355
Worker	0.729	66,200	1,830	9,460,000	*1,000	284	4,730	4,730
DTSC Generic Clean Closure Levels**	0.3	5,000	9.0	70,000 (III) 0.2 (VI)	130	21	NA	NA

NOTES:

* - based on DTSC Leadsread exposure model

** - the levels can be used provided there is no potential for groundwater impacts

Source: ESE.

APPENDIX A

RCRA CLOSURE INORGANIC SOIL SAMPLE RESULTS

TABLE A-1. ANALYTICAL RESULTS FOR RCRA CLOSURE SOIL SAMPLES,
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 1 of 4)

[illegible]

TABLE A-1. ANALYTICAL RESULTS FOR RCRA CLOSURE SOIL SAMPLES,
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 2 of 4)

Sample ID:	ST-2-6	ST-2-18						
Laboratory ID:	12716-7	12716-8						
Sampling Date:	5-21-93	5-21-93						
	mg/kg	mg/kg						
METALS								
Arsenic	1.7	1.9						
Barium	ND (40.0)	ND (40.0)						
Cadmium	ND (1.0)	ND (1.0)						
Chromium	32.0 J	31.5 J						
Lead	ND (10.0)	ND (10.0)						
Mercury	ND (0.10)	ND (0.10)						
Selenium	ND (1.0)	ND (1.0)						
Silver	ND (2.0)	ND (2.0)						

**TABLE A-1. ANALYTICAL RESULTS FOR RCRA CLOSURE SOIL RESAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 3 of 4)**

[illegible]

**TABLE A-1. ANALYTICAL RESULTS FOR RCRA CLOSURE SOIL RESAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 4 of 4)**

Sample ID: Laboratory ID: Sampling Date:	SWT-1-18 14982-8 10-07-93	SWT-2-6 14982-9 10-07-93	SWT-2-18 14982-10 10-07-93					
METALS	mg/kg	mg/kg	mg/kg					
Chromium (Hexavalent)	ND (0.2)J	ND (0.2)J	ND (0.2)J					

NOTES:

Values reported are based on dry weight

Arsenic values reported are above the "Generic Clean Closure Level"

ND - not detected above method detection limit

() - method detection limit.

J - a validation code indicating that the reported value has been flagged as an estimated value usable as qualified

APPENDIX B

RFI INORGANIC SOIL SAMPLE RESULTS

TABLE B-1. METAL RESULTS FOR ADDITIONAL ASSESSMENT SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 1 of 3)

Sample ID: Laboratory ID: Sampling Date:	AA-B1-1 14981-11 10-07-93	AA-B1-3 14981-12 10-07-93	AA-B1-5 14981-13 10-07-93	AA-B1-10 14981-14 10-07-93	AA-B2-1 14981-15 10-07-93	AA-B2-3 14981-16 10-07-93	AA-B2-5 14981-17 10-07-93	AA-B2-10 14981-18 10-07-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	2.6	NA	2.3	1.3	20.8	NA	3.8	0.53
Barium	127	NA	41.0	ND (40.0)	48.3	NA	62.7	ND (40.0)
Cadmium	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)
Chromium (Total)	18.3	NA	16.6	14.4	7.5	NA	14.8	5.6
Chromium (Hexavalent)	ND (0.2)	NA	ND (0.2)	ND (0.2)	ND (0.2)	NA	ND (0.2)	ND (0.2)
Lead	12.0	NA	ND (10.0)	ND (10.0)	13.5	NA	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	NA	ND (0.10)	ND (0.10)	ND (0.10)	NA	ND (0.10)	ND (0.10)
Selenium	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)
Silver	ND (2.0)	NA	ND (2.0)	ND (2.0)	ND (2.0)	NA	ND (2.0)	ND (2.0)

Continued...

TABLE B-1. METAL RESULTS FOR ADDITIONAL ASSESSMENT SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 2 of 3)

Sample ID: Laboratory ID: Sampling Date:	AA-B3-1 14981-19 10-07-93	AA-B3-3 14981-20 10-07-93	AA-B3-5 14981-21 10-07-93	AA-B3-10 14981-22 10-07-93	AA-B4-2 14981-1 10-07-93	AA-B4-3 14981-2 10-07-93	AA-B4-5 14981-3 10-07-93	AA-B4-10 14981-4 10-07-93
METALS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	21.3	3.4	1.4	1.3	2.1	2.4 J	2.1	2.8
Barium	41.8	139	ND (40.0)	ND (40.0)	ND (40.0)	ND (40.0)	174	47.5
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	3500	ND (1.0)
Chromium (Total)	4.9	16.4	8.5	11.4	18.2	18.2	89.2	19.6
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	11.3	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	5780	ND (10.0)
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	41.6	ND (2.0)

Continued...

**TABLE B-1. METAL RESULTS FOR ADDITIONAL ASSESSMENT SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 3 of 3)**

Sample ID: Laboratory ID: Sampling Date:	AA-B5-1 14981-6 10-07-93	AA-B5-3 14981-7 10-07-93	AA-B5-5 14981-8 10-07-93	AA-B5-10 14981-9 10-07-93				
	mg/kg	mg/kg	mg/kg	mg/kg				
METALS								
Arsenic	3.2	1.6 J	0.68	2.4				
Barium	41.1	ND (40.0)	ND (40.0)	ND (40.0)				
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)				
Chromium (Total)	19.6	13.8	7.7	19.5				
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J				
Lead	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)				
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)				
Selenium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)				
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)				

NOTES:

Results reported are based on dry weight

Arsenic values reported are above the "Generic Clean Closure Level"

ND - not detected

() - method detection limit, except for the metals arsenic and hexavalent chromium which are the "Generic Clean Closure Levels"

NA - not analyzed

J - a data validation code indicating the result has been flagged as an estimated value usable as qualified

**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 1 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S1-B1-0.5 14936-30 10-06-93	S1-B1-3 14936-31 10-06-93	S1-B1-5 14936-32 10-06-93	S1-B1-10 14936-33 10-06-93	S5-B1-1 14917-24 10-05-93	S5-B1-3 10-05-93	S5-B1-5 14917-26 10-05-93	S5-B1-10 14917-27 10-05-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	NA	NA	NA	NA	2.9	NA	1.6	2.3
Barium	NA	NA	NA	NA	59.3	NA	40.8	51.4
Cadmium	NA	NA	NA	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)
Chromium (Total)	NA	NA	NA	NA	14.0	NA	14.4	12.9
Chromium (Hexavalent)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2) J	NA	ND (0.2) J	ND (0.2) J
Lead	NA	NA	NA	NA	69.8	NA	ND (10.0)	ND (10.0)
Mercury	NA	NA	NA	NA	ND (0.10)	NA	ND (0.10)	ND (0.10)
Selenium	NA	NA	NA	NA	ND (1.0) J	NA	ND (1.0) J	ND (1.0)
Silver	NA	NA	NA	NA	ND (2.0)	NA	ND (2.0)	ND (2.0)

Continued...

TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 2 of 14)

Sample ID: Laboratory ID: Sampling Date:	S5-B2-1 14937-25 10-06-93	S5-B2-3 14937-26 10-06-93	S5-B2-5 14937-27 10-06-93	S5-B2-10 14937-28 10-06-93	S5-B3-1 14917-29 10-05-93	S5-B3-3 14917-30 10-05-93	S5-B3-5 14937-1 10-05-93	S5-B3-10 14937-2 10-05-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	2.0	3.9 J	1.3	36.9	5.9	6.5 J	1.1	2.1
Barium	40.7	93.1	ND (40.0)	ND (40.0)	52.7	50.5	ND (40.0)	41.3
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	61.6	19.2	9.7	14.6	11.1	11.9	25.7	21.8
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	34.8	15.0	ND (10.0)	ND (10.0)	31.0	29.0	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	0.15	0.18	ND (0.10)	ND (0.10)
Selenium	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0)
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

Continued...

TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 3 of 14)

Sample ID: Laboratory ID: Sampling Date:	S5-B4-1 14980-1 10-07-93	S5-B4-3 14980-2 10-07-93	S5-B4-5 14980-3 10-07-93	S5-B4-10 14980-4 10-07-93	S6-B1-1 14937-21 10-06-93	S6-B1-3 14937-22 10-06-93	S6-B1-5 14937-23 10-06-93	S6-B1-10 14937-24 10-06-93
METALS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	0.49	1.6	1.9	2.3	0.75	2.0 J	3.6	1.7
Barium	ND (40.0)	47.3	ND (40.0)	ND (40.0)	92.5 J	41.2	52.6 J	63.3 J
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.6	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	ND (2.0)	14.7	11.4	8.7	36.1 J	31.6	32.4 J	18.2 J
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	17.8	ND (10.0)	ND (10.0)	ND (10.0)	23.6 J	10.5	19.0 J	ND (10.0) J
Mercury	ND (0.10)J	ND (0.10)	ND (0.10)J	ND (0.10)J	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0) J
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

Continued...

**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 4 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S6-B2-1 14937-17 10-06-93	S6-B2-3 10-06-93	S6-B2-5 14937-19 10-06-93	S6-B2-10 14937-20 10-06-93	S6-B3-1 14937-14 10-06-93	S6-B3-3 14937-15 10-06-93	S6-B3-5 14937-16 10-06-93	S6-B3-10 14936-1 10-06-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	0.95	NA	1.3	1.7	2.6	1.3 J	1.1	2.0
Barium	ND (40.0) J	NA	ND (40.0) J	51.1 J	ND (40.0) J	ND (40.0)	ND (40.0) J	104.0 J
Cadmium	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	14.6 J	NA	9.5 J	20.2 J	12.6 J	10.1	7.8 J	23.2 J
Chromium (Hexavalent)	ND (0.2) J	NA	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	ND (10.0) J	NA	ND (10.0) J	ND (10.0) J	ND (10.0) J	ND (10.0)	ND (10.0) J	ND (10.0) J
Mercury	ND (0.10)	NA	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0) J	NA	ND (1.0) J	ND (1.0) J	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0) J
Silver	ND (2.0)	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

Continued...

TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 5 of 14)

Sample ID: Laboratory ID: Sampling Date:	S6-B4-1 14936-2 10-06-93	S6-B4-3 14936-3 10-06-93	S6-B4-5 14936-4 10-06-93	S6-B4-10 14936-5 10-06-93	S6-B5-1 14980-6 10-07-93	S6-B5-3 14980-7 10-07-93	S6-B5-5 14980-8 10-07-93	S6-B5-10 14980-9 10-07-93
METALS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	1.9	1.9 J	1.5	1.8	8.1	6.3	2.8	3.9
Barium	ND (40.0) J	ND (40.0)	ND (40.0) J	92.3 J	ND (40.0)	45.1	ND (40.0)	ND (40.0)
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	19.0 J	9.0	7.6 J	20.2 J	55.9	41.3	101	80.8
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	ND (10.0) J	ND (10.0)	ND (10.0) J	ND (10.0) J	ND (10.0)	50.4	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)J	0.18	ND (0.10)J	ND (0.10)J
Selenium	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

Continued...

**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 6 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S7-B1-1 14936-18 10-06-93	S7-B1-3 14936-19 10-06-93	S7-B1-5 14936-20 10-06-93	S7-B1-10 14936-21 10-06-93	S7-B2-1 14936-22 10-06-93	S7-B2-3 14936-23 10-06-93	S7-B2-5 14936-24 10-06-93	S7-B2-10 14936-25 10-06-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	2.5	1.8 J	1.9	2.0	2.2	2.0 J	1.7	2.9
Barium	49.8	ND (40.0)	ND (40.0)	66.3	ND (40.0)	ND (40.0)	ND (40.0)	ND (40.0)
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	12.4	11.1	9.8	10.4	10.7	12.0	9.7	10.7
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	15.3	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

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TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 7 of 14)

Sample ID: Laboratory ID: Sampling Date:	S7-B3-1 14936-26 10-06-93	S7-B3-3 14936-27 10-06-93	S7-B3-5 14936-28 10-06-93	S7-B3-10 14936-29 10-06-93	S8-B1-1 14917-1 10-05-93	S8-B1-3 14917-2 10-05-93	S8-B1-5 14917-3 10-05-93	S8-B1-10 14917-4 10-05-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	2.3	1.9 J	2.2	1.9	1.4	2.3 J	2.2	0.60
Barium	41.8	ND (40.0)	ND (40.0)	ND (40.0)	ND (40.0)	ND (40.0)	ND (40.0)	ND (40.0)
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	10.9	12.5	10.7	11.2	6.8	11.9	11.2	6.8
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	11.0	ND (10.0)	ND (10.0)	ND (10.0)	44.1	15.8	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0) J
Silver	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)J	ND (2.0)	ND (2.0)

Continued...

**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 8 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S8-B2-1 14937-29 10-06-93	S8-B2-3 14937-30 10-06-93	S8-B2-5 14937-31 10-06-93	S8-B2-10 14937-32 10-06-93	S8-B3-1 14937-10 10-06-93	S8-B3-3 14937-11 10-06-93	S8-B3-5 14937-12 10-06-93	S8-B3-10 14937-13 10-06-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	1.5	3.3 J	2.6	1.8	2.0	4.7 J	3.3	1.7
Barium	ND (40.0)	ND (40.0)	57.4	ND (40.0)	392	ND (40.0)	ND (40.0)	43.4
Cadmium	ND (1.0)	1.6	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	7.2	6.8	13.0	11.5	4.3	13.7	12.0	10.8
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	11.7	46.0	ND (10.0)	ND (10.0)	20.2	ND (10.0)	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	0.19	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

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**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 9 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S8-B4-1 14937-3 10-06-93	S8-B4-3 14937-4 10-06-93	S8-B4-5 14937-5 10-06-93	S8-B4-10 14937-6 10-06-93	S8-B6-1 14917-20 10-05-93	S8-B6-3 14917-21 10-05-93	S8-B6-5 14917-22 10-05-93	S8-B6-10 14917-23 10-05-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	5.5	5.7 J	2.0	2.5	1.5	2.8 J	1.5	1.2
Barium	425	43.3	ND (40.0)	53.3	46.8	ND (40.0)	ND (40.0)	ND (40.0)
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	56.8	24.2	12.6	12.5	9.3	12.1	10.7	8.3
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	150	31.8	ND (10.0)	ND (10.0)	37.7	ND (10.0)	45.2	ND (10.0)
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0) J
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

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**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 10 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S8-B7-1 14917-5 10-05-93	S8-B7-3 14917-6 10-05-93	S8-B7-5 14917-7 10-05-93	S8-B7-10 14917-8 10-05-93	S9-B1-1	S9-B1-3 14917-9 10-05-93	S9-B1-5 14917-10 10-05-93	S9-B1-10 14917-11 10-05-93
METALS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	2.6	2.9 J	2.1	0.62	NS	2.5 J	1.8	1.9
Barium	40.7	ND (40.0)	ND (40.0)	ND (40.0)	NS	ND (40.0)	ND (40.0)	ND (40.0)
Cadmium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NS	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	8.7	13.6	12.8	6.5	NS	10.0	11.9	12.0
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	NS	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	37.9	ND (10.0)	12.1	ND (10.0)	NS	27.5	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	NS	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0) J	ND (1.0)	ND (1.0) J	ND (1.0) J	NS	ND (1.0)	ND (1.0) J	ND (1.0) J
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	NS	ND (2.0) J	ND (2.0)	ND (2.0)

Continued...

**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 11 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S9-B2-1 14917-12 10-05-93	S9-B2-3 10-05-93	S9-B2-5 14917-13 10-05-93	S9-B2-10 14917-15 10-05-93	S9-B3-1 14917-16 10-05-93	S9-B3-3 10-05-93	S9-B3-5 14917-18 10-05-93	S9-B3-10 14917-19 10-05-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	2.3	NA	6.8	1.3	6.0	NA	1.0	1.3
Barium	ND (40.0)	NA	53.8	ND (40.0)	163	NA	ND (40.0)	ND (40.0)
Cadmium	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)
Chromium (Total)	9.8	NA	12.9	8.3	12.4	NA	7.2	9.9
Chromium (Hexavalent)	ND (0.2) J	NA	ND (0.2) J	ND (0.2) J	ND (0.2) J	NA	ND (0.2) J	ND (0.2) J
Lead	ND (10.0)	NA	79.4	ND (10.0)	3,720	NA	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	NA	ND (0.10)	ND (0.10)	ND (0.10)	NA	ND (0.10)	ND (0.10)
Selenium	ND (1.0) J	NA	ND (1.0) J	ND (1.0) J	ND (1.0) J	NA	ND (1.0) J	ND (1.0) J
Silver	ND (2.0)	NA	ND (2.0)	ND (2.0)	ND (2.0)	NA	ND (2.0)	ND (2.0)

Continued...

**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 12 of 14)**

Sample ID:	S10-B1-1	S10-B1-3	S10-B1-5	S10-B1-10	S10-B2-1	S10-B2-3	S10-B2-5	S10-B2-10
Laboratory ID:	14980-23	14980-24	14980-25	14980-26	14980-17	14980-18	14980-19	14980-20
Sampling Date:	10-07-93	10-07-93	10-07-93	10-07-93	10-07-93	10-07-93	10-07-93	10-07-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg
METALS								
Arsenic	3.1	3.2 J	2.8	2.1	3.0	15.0 J	2.5	2.3
Barium	ND (40.0)	41.2	ND (40.0)	ND (40.0)	40.3	50.7	ND (40.0)	ND (40.0)
Cadmium	ND (1.0)	1.1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	12.6	10.8	13.0	12.2	9.1	15.5	11.9	11.9
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	ND (10.0)	25.6	ND (10.0)	ND (10.0)	52.0	52.4	ND (10.0)	ND (10.0)
Mercury	ND (0.10)J	ND (0.10)	ND (0.10)J	ND (0.10)J	ND (0.10)J	ND (0.10)	ND (0.10)J	ND (0.10)J
Selenium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

Continued...

**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 13 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S11-B1-1 14936-6 10-06-93	S11-B1-3 14936-7 10-06-93	S11-B1-5 14936-8 10-06-93	S11-B1-10 14936-9 10-06-93	S11-B2-1 14936-10 10-06-93	S11-B2-3 14936-11 10-06-93	S11-B2-5 14936-12 10-06-93	S11-B2-10 14936-13 10-06-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	2.2	1.4 J	3.7	2.0	8.8	1.3 J	1.9	2.4
Barium	44.4 J	ND (40.0)	121	54.5	154	ND (40.0)	ND (40.0)	48.7
Cadmium	2.9	ND (1.0)	1.7	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	18.4	10.9	20.5	14.7	4.1	10.4	10.2	12.3
Chromium (Hexavalent)	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	15.3	62.8	413	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Selenium	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Silver	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

Continued...

**TABLE B-1. METAL RESULTS FOR RCRA PHASE 1 RFI SOIL SAMPLES
ALLIED-SIGNAL SOLVENT CENTER, SAN DIEGO, CALIFORNIA (PAGE 14 of 14)**

Sample ID: Laboratory ID: Sampling Date:	S11-B3-1 14936-14 10-06-93	S11-B3-3 10-06-93	S11-B3-5 14936-16 10-06-93	S11-B3-10 14936-17 10-06-93	S11-B4-1 14980-13 10-07-93	S11-B4-3 14980-14 10-07-93	S11-B4-5 14980-15 10-07-93	S11-B4-10 14980-16 10-07-93
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
METALS								
Arsenic	2.3	NA	8.3	2.4	2.2	2.4 J	1.3	2.4
Barium	40.7	NA	103	50.7	ND (40.0)	41.9	ND (40.0)	ND (40.0)
Cadmium	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Chromium (Total)	18.3	NA	6.2	13.0	24.2	18.3	9.2	15.0
Chromium (Hexavalent)	ND (0.2) J	NA	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J	ND (0.2) J
Lead	17.3	NA	ND (10.0)	ND (10.0)	21.4	ND (10.0)	ND (10.0)	ND (10.0)
Mercury	ND (0.10)	NA	ND (0.10)	ND (0.10)	ND (0.10)J	ND (0.10)	ND (0.10)J	ND (0.10)J
Selenium	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Silver	ND (2.0)	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0) J	ND (2.0)	ND (2.0)

NOTES:

Results reported are based on dry weight. Arsenic values reported are above the "Generic Clean Closure Level"

() - method detection limit, except for the metals arsenic and hexavalent chromium which are the "Generic Clean Closure Levels"

NA - not analyzed

ND - not detected

NS - no sample collected

J - a data validation code indicating the result has been flagged as an estimated value usable as qualified

APPENDIX C
CHEMICAL-SPECIFIC RISK AND HI RESULTS

Table C-1. HI and Risk Calculations for Future Residential Exposure to Mean Inorganic Concentrations in Background Soils.

Chemical	Mean Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral RfD (mg/kg/day)	Oral CSF (mg/kg/day)	Noncarcinogenic HQ			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	6.60E+00	0.03	8.44E-05	2.53E-05	1.03E-05	3.72E-06	3.0E-04	1.8E+00	2.8E-01	8.4E-02	3.7E-01	1.8E-05	6.5E-06	2.5E-05
Lead	2.90E+01	0.01	3.71E-04	3.71E-05	4.54E-05	5.45E-06	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	6.87E+02	0.01	8.78E-03	8.78E-04	-	-	7.0E-02	-	1.3E-01	1.3E-02	1.4E-01	-	-	-
Cadmium	3.50E+00	0.001	4.47E-05	4.47E-07	-	-	1.0E-03	-	4.5E-02	4.5E-04	4.5E-02	-	-	-
Chromium	1.18E+02	0.01	1.51E-03	1.51E-04	-	-	1.0E+00	-	1.5E-03	1.5E-04	1.7E-03	-	-	-
Mercury	1.54E-01	0.01	1.97E-06	1.97E-07	-	-	3.0E-04	-	6.6E-03	6.6E-04	7.2E-03	-	-	-
Selenium	2.90E-01	0.01	3.71E-06	3.71E-07	-	-	5.0E-03	-	7.4E-04	7.4E-05	8.2E-04	-	-	-
Silver	5.00E-01	0.01	6.39E-06	6.39E-07	-	-	5.0E-03	-	1.3E-03	1.3E-04	1.4E-03	-	-	-
TOTAL											5.60E-01			2.5E-05

Note:

(a) Arithmetic mean chemical concentration in soil.

(b) TOTAL HQ = oral HQ + dermal HQ = HI.

(c) Based on trivalent chromium since hexavalent chromium results were below detection limits.

Source: ESE.

Table C-2. HI and Risk Calculations for Future Residential Exposure to Maximum Inorganic Concentrations in Background Soil.

Chemical	Maximum Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral HI (mg/kg/day)	Oral CSI (mg/kg/day)	Noncarcinogenic HQ			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	6.90E+01	0.03	8.82E-04	2.65E-04	1.08E-04	3.89E-05	3.0E-04	1.8E+00	2.9E+00	8.8E-01	3.8E+00	1.9E-04	6.8E-05	2.6E-04
Lead	3.00E+02	0.01	3.84E-03	3.84E-04	4.70E-04	5.63E-05	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	1.50E+03	0.01	1.92E-02	1.92E-03	-	-	7.0E-02	-	2.7E-01	2.7E-02	3.0E-01	-	-	-
Cadmium	2.20E+01	0.001	2.81E-04	2.81E-06	-	-	1.0E-03	-	2.8E-01	2.8E-03	2.8E-01	-	-	-
Chromium	1.50E+03	0.01	1.92E-02	1.92E-03	-	-	1.0E+00	-	1.9E-02	1.9E-03	2.1E-02	-	-	-
Mercury	1.50E+00	0.01	1.92E-05	1.92E-06	-	-	3.0E-04	-	6.4E-02	6.4E-03	7.0E-02	-	-	-
Selenium	1.50E+00	0.01	1.92E-05	1.92E-06	-	-	5.0E-03	-	3.8E-03	3.8E-04	4.2E-03	-	-	-
Silver	5.00E+00	0.01	6.39E-05	6.39E-06	-	-	5.0E-03	-	1.3E-02	1.3E-03	1.4E-02	-	-	-
TOTAL											4.52E+00			2.6E-04

Source: ESE.

Table C-3. HI and Risk Calculations for Future Worker Exposure to Mean Inorganic Concentrations in Background Soil.

Chemical	Mean Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral RfD (mg/kg/day)	Oral CSF (mg/kg/day) ⁻¹	Noncarcinogenic HI			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	6.60E+00	0.03	3.23E-06	1.12E-05	1.15E-06	4.02E-06	3.0E-04	1.8E+00	1.1E-02	3.7E-02	4.8E-02	2.0E-06	7.0E-06	9.1E-06
Lead	2.90E+01	0.01	1.42E-05	1.65E-05	5.07E-06	5.89E-06	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	6.87E+02	0.01	3.36E-04	3.90E-04	-	-	7.0E-02	-	4.8E-03	5.6E-03	1.0E-02	-	-	-
Cadmium	3.50E+00	0.001	1.71E-06	1.99E-07	-	-	1.0E-03	-	1.7E-03	2.0E-04	1.9E-03	-	-	-
Chromium	1.18E+02	0.01	5.77E-05	6.70E-05	-	-	1.0E+00	-	5.8E-05	6.7E-05	1.2E-04	-	-	-
Mercury	1.54E-01	0.01	7.53E-08	8.74E-08	-	-	3.0E-04	-	2.5E-04	2.9E-04	5.4E-04	-	-	-
Selenium	2.90E-01	0.01	1.42E-07	1.65E-07	-	-	5.0E-03	-	2.8E-05	3.3E-05	6.1E-05	-	-	-
Silver	5.00E-01	0.01	2.45E-07	2.84E-07	-	-	5.0E-03	-	4.9E-05	5.7E-05	1.1E-04	-	-	-
TOTAL											6.13E-02			9.1E-06

Source: ESE.

Table C-4. HI and Risk Calculations for Future Worker Exposure to Maximum Inorganic Concentrations in Background Soil.

Chemical	Maximum Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral HI (mg/kg/day)	Oral CSF (mg/kg/day) ⁻¹	Noncarcinogenic HQ			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	6.90E+01	0.03	3.38E-05	1.17E-04	1.21E-05	4.20E-05	3.0E-04	1.8E+00	1.1E-01	3.9E-01	5.0E-01	2.1E-05	7.4E-05	9.5E-05
Lead	3.00E+02	0.01	1.47E-04	1.70E-04	5.24E-05	6.09E-05	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	1.50E+03	0.01	7.34E-04	8.51E-04	-	-	7.0E-02	-	1.0E-02	1.2E-02	2.3E-02	-	-	-
Cadmium	2.20E+01	0.001	1.08E-05	1.25E-06	-	-	1.0E-03	-	1.1E-02	1.2E-03	1.2E-02	-	-	-
Chromium	1.50E+03	0.01	7.34E-04	8.51E-04	-	-	1.0E+00	-	7.3E-04	8.5E-04	1.6E-03	-	-	-
Mercury	1.50E+00	0.01	7.34E-07	8.51E-07	-	-	3.0E-04	-	2.4E-03	2.8E-03	5.3E-03	-	-	-
Selenium	1.50E+00	0.01	7.34E-07	8.51E-07	-	-	5.0E-03	-	1.5E-04	1.7E-04	3.2E-04	-	-	-
Silver	5.00E+00	0.01	2.45E-06	2.84E-06	-	-	5.0E-03	-	4.9E-04	5.7E-04	1.1E-03	-	-	-
TOTAL											5.47E-01			9.5E-05

Source: ESE.

Table C-5. HI and Risk Calculations for Future Residential Exposure to Mean Inorganic Concentrations in Soil at SWMUs # 1, 3, 4, 5, 6, 8, 11.

Chemical	Mean Conc. in Soil (a) (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral RfD (mg/kg/day)	Oral CSF (mg/kg/day) ⁻¹	Noncarcinogenic HI			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL (b)	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	3.10E+00	0.03	3.96E-05	1.19E-05	4.85E-06	1.75E-06	3.0E-04	1.8E+00	1.3E-01	4.0E-02	1.7E-01	8.5E-06	3.1E-06	1.2E-05
Lead	2.38E+01	0.01	3.04E-04	3.04E-05	3.73E-05	4.47E-06	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	5.96E+01	0.01	7.62E-04	7.62E-05	-	-	7.0E-02	-	1.1E-02	1.1E-03	1.2E-02	-	-	-
Cadmium	6.00E-01	0.001	7.67E-06	7.67E-08	-	-	1.0E-03	-	7.7E-03	7.7E-05	7.7E-03	-	-	-
Chromium (c)	1.85E+01	0.01	2.37E-04	2.37E-05	-	-	1.0E+00	-	2.4E-04	2.4E-05	2.6E-04	-	-	-
Mercury	1.00E-01	0.01	1.28E-06	1.28E-07	-	-	3.0E-04	-	4.3E-03	4.3E-04	4.7E-03	-	-	-
Selenium	5.00E-01	0.01	6.39E-06	6.39E-07	-	-	5.0E-03	-	1.3E-03	1.3E-04	1.4E-03	-	-	-
Silver	1.00E+00	0.01	1.28E-05	1.28E-06	-	-	5.0E-03	-	2.6E-03	2.6E-04	2.8E-03	-	-	-
TOTAL											2.01E-01			1.2E-05

Source: ESE.

Table C-6. HI and Risk Calculations for Future Residential Exposure to Maximum Inorganic Concentrations in Soil at SWMUs # 1, 3, 4, 5, 6, 8, 11.

Chemical	Maximum Conc. in Soil (mg/kg)	AES	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral HI (mg/kg/day)	Oral CSI (mg/kg/day)	Noncarcinogenic HQ			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	9.30E+00	0.03	1.19E-04	3.57E-05	1.46E-05	5.24E-06	3.0E-04	1.8E+00	4.0E-01	1.2E-01	5.2E-01	2.5E-05	9.2E-06	3.5E-05
Lead	1.50E+02	0.01	1.92E-03	1.92E-04	2.35E-04	2.82E-05	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	4.25E+02	0.01	5.43E-03	5.43E-04	-	-	7.0E-02	-	7.8E-02	7.8E-03	8.5E-02	-	-	-
Cadmium	2.90E+00	0.001	3.71E-05	3.71E-07	-	-	1.0E-03	-	3.7E-02	3.7E-04	3.7E-02	-	-	-
Chromium	6.16E+01	0.01	7.88E-04	7.88E-05	-	-	1.0E+00	-	7.9E-04	7.9E-05	8.7E-04	-	-	-
Mercury	2.00E-01	0.01	2.56E-06	2.56E-07	-	-	3.0E-04	-	8.5E-03	8.5E-04	9.4E-03	-	-	-
Selenium	5.00E-01	0.01	6.39E-06	6.39E-07	-	-	5.0E-03	-	1.3E-03	1.3E-04	1.4E-03	-	-	-
Silver	1.00E+00	0.01	1.28E-05	1.28E-06	-	-	5.0E-03	-	2.6E-03	2.6E-04	2.8E-03	-	-	-
TOTAL											6.53E-01			3.5E-05

Source: ESE.

Table C-7. HI and Risk Calculations for Future Worker Exposure to Mean Inorganic Concentrations in Soil at SWMUs #1, 3, 4, 5, 6, 8, 11.

Chemical	Mean Conc. in Soil (mg/kg)	AES	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral RfD (mg/kg/day)	Oral CSF (mg/kg/day)	Noncarcinogenic HQ			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	3.10E+00	0.03	1.52E-06	5.28E-06	5.42E-07	1.89E-06	3.0E-04	1.8E+00	5.1E-03	1.8E-02	2.3E-02	9.5E-07	3.3E-06	4.3E-06
Lead	2.38E+01	0.01	1.16E-05	1.35E-05	4.16E-06	4.83E-06	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	5.96E+01	0.01	2.92E-05	3.38E-05	-	-	7.0E-02	-	4.2E-04	4.8E-04	9.0E-04	-	-	-
Cadmium	6.00E-01	0.001	2.94E-07	3.41E-08	-	-	1.0E-03	-	2.9E-04	3.4E-05	3.3E-04	-	-	-
Chromium	1.85E+01	0.01	9.05E-06	1.05E-05	-	-	1.0E+00	-	9.1E-06	1.0E-05	2.0E-05	-	-	-
Mercury	1.00E-01	0.01	4.89E-08	5.68E-08	-	-	3.0E-04	-	1.6E-04	1.9E-04	3.5E-04	-	-	-
Selenium	5.00E-01	0.01	2.45E-07	2.84E-07	-	-	5.0E-03	-	4.9E-05	5.7E-05	1.1E-04	-	-	-
Silver	1.00E+00	0.01	4.89E-07	5.68E-07	-	-	5.0E-03	-	9.8E-05	1.1E-04	2.1E-04	-	-	-
TOTAL											2.46E-02			4.3E-06

Source: ESE.

Table C-8. HI and Risk Calculations for Future Worker Exposure to Maximum Inorganic Concentrations in Soil at SWMUs #1, 3, 4, 5, 6, 8, 11.

Chemical	Maximum Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral HD (mg/kg/day)	Oral CSF (mg/kg/day)	Noncarcinogenic HI			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	9.30E+00	0.03	4.55E-06	1.58E-05	1.62E-06	5.67E-06	3.0E-04	1.8E+00	1.5E-02	5.3E-02	6.8E-02	2.8E-06	9.9E-06	1.3E-05
Lead	1.50E+02	0.01	7.34E-05	8.51E-05	2.62E-05	3.05E-05	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	4.25E+02	0.01	2.08E-04	2.41E-04	-	-	7.0E-02	-	3.0E-03	3.4E-03	6.4E-03	-	-	-
Cadmium	2.90E+00	0.001	1.42E-06	1.65E-07	-	-	1.0E-03	-	1.4E-03	1.6E-04	1.6E-03	-	-	-
Chromium	6.16E+01	0.01	3.01E-05	3.50E-05	-	-	1.0E+00	-	3.0E-05	3.5E-05	6.5E-05	-	-	-
Mercury	2.00E-01	0.01	9.78E-08	1.14E-07	-	-	3.0E-04	-	3.3E-04	3.8E-04	7.0E-04	-	-	-
Selenium	5.00E-01	0.01	2.45E-07	2.84E-07	-	-	5.0E-03	-	4.9E-05	5.7E-05	1.1E-04	-	-	-
Silver	1.00E+00	0.01	4.89E-07	5.68E-07	-	-	5.0E-03	-	9.8E-05	1.1E-04	2.1E-04	-	-	-
TOTAL											7.70E-02			1.3E-05

Source: ESE.

Table C-9. HI and Risk Calculations for Future Residential Exposure to Mean Inorganic Concentrations Detected in Sitewide Soil.

Chemical	Mean Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral RfD (mg/kg/day)	Oral CSF (mg/kg/day)	Noncarcinogenic HQ			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	3.85E+00	0.03	4.92E-05	1.48E-05	6.03E-06	2.17E-06	3.0E-04	1.8E+00	1.6E-01	4.9E-02	2.1E-01	1.1E-05	3.8E-06	1.4E-05
Lead	8.60E+01	0.01	1.10E-03	1.10E-04	1.35E-04	1.61E-05	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	5.43E+01	0.01	6.94E-04	6.94E-05	-	-	7.0E-02	-	9.9E-03	9.9E-04	1.1E-02	-	-	-
Cadmium	5.90E-01	0.001	7.54E-06	7.54E-08	-	-	1.0E-03	-	7.5E-03	7.5E-05	7.6E-03	-	-	-
Chromium	1.62E+01	0.01	2.07E-04	2.07E-05	-	-	1.0E+00	-	2.1E-04	2.1E-05	2.3E-04	-	-	-
Mercury	6.00E-02	0.01	7.67E-07	7.67E-08	-	-	3.0E-04	-	2.6E-03	2.6E-04	2.8E-03	-	-	-
Selenium	5.00E-01	0.01	6.39E-06	6.39E-07	-	-	5.0E-03	-	1.3E-03	1.3E-04	1.4E-03	-	-	-
Silver	1.00E+00	0.01	1.28E-05	1.28E-06	-	-	5.0E-03	-	2.6E-03	2.6E-04	2.8E-03	-	-	-
TOTAL											2.39E-01			1.4E-05

Source: ESE.

Table C-10. HI and Risk Calculations for Future Residential Exposure to Maximum Concentrations of Inorganics Detected in Sitewide Soil.

Chemical	Maximum Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral HI (mg/kg/day)	Oral CSF (mg/kg/day) ¹	Noncarcinogenic HI			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	2.13E+01	0.03	2.72E-04	8.17E-05	3.33E-05	1.20E-05	3.0E-04	1.8E+00	9.1E-01	2.7E-01	1.2E+00	5.8E-05	2.1E-05	7.9E-05
Lead	3.72E+03	0.01	4.76E-02	4.76E-03	5.82E-03	6.99E-04	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	4.25E+02	0.01	5.43E-03	5.43E-04	-	-	7.0E-02	-	7.8E-02	7.8E-03	8.5E-02	-	-	-
Cadmium	2.90E+00	0.001	3.71E-05	3.71E-07	-	-	1.0E-03	-	3.7E-02	3.7E-04	3.7E-02	-	-	-
Chromium	6.16E+01	0.01	7.88E-04	7.88E-05	-	-	1.0E+00	-	7.9E-04	7.9E-05	8.7E-04	-	-	-
Mercury	1.90E-01	0.01	2.43E-06	2.43E-07	-	-	3.0E-04	-	8.1E-03	8.1E-04	8.9E-03	-	-	-
Selenium	5.00E-01	0.01	6.39E-06	6.39E-07	-	-	5.0E-03	-	1.3E-03	1.3E-04	1.4E-03	-	-	-
Silver	1.00E+00	0.01	1.28E-05	1.28E-06	-	-	5.0E-03	-	2.6E-03	2.6E-04	2.8E-03	-	-	-
TOTAL											1.32E+00			7.9E-05

Source: ESE.

Table C-11. HI and Risk Calculations for Future Worker Exposure to Mean Inorganic Concentrations Detected in Site-wide Soil.

Chemical	Mean Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral RfD (mg/kg/day)	Oral CSF (mg/kg/day) ¹	Noncarcinogenic HI			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	3.85E+00	0.03	1.88E-06	6.55E-06	6.73E-07	2.35E-06	3.0E-04	1.8E+00	6.3E-03	2.2E-02	2.8E-02	1.2E-06	4.1E-06	5.3E-06
Lead	8.60E+01	0.01	4.21E-05	4.88E-05	1.50E-05	1.75E-05	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	5.43E+01	0.01	2.66E-05	3.08E-05	-	-	7.0E-02	-	3.8E-04	4.4E-04	8.2E-04	-	-	-
Cadmium	5.90E-01	0.001	2.89E-07	3.35E-08	-	-	1.0E-03	-	2.9E-04	3.3E-05	3.2E-04	-	-	-
Chromium	1.62E+01	0.01	7.93E-06	9.19E-06	-	-	1.0E+00	-	7.9E-06	9.2E-06	1.7E-05	-	-	-
Mercury	6.00E-02	0.01	2.94E-08	3.41E-08	-	-	3.0E-04	-	9.8E-05	1.1E-04	2.1E-04	-	-	-
Selenium	5.00E-01	0.01	2.45E-07	2.84E-07	-	-	5.0E-03	-	4.9E-05	5.7E-05	1.1E-04	-	-	-
Silver	1.00E+00	0.01	4.89E-07	5.68E-07	-	-	5.0E-03	-	9.8E-05	1.1E-04	2.1E-04	-	-	-
TOTAL											2.98E-02			5.3E-06

Source: ESE.

Table C-12. HI and Risk Calculations for Future Worker Exposure to Maximum Inorganic Concentrations Detected in Site-wide Soil.

Chemical	Maximum Conc. in Soil (mg/kg)	ABS	Noncarcinogenic Daily Intake (mg/kg/day)		Carcinogenic Daily Intake (mg/kg/day)		Oral RfD (mg/kg/day)	Oral CSF (mg/kg/day)	Noncarcinogenic HI			Carcinogenic Risk		
			Oral	Dermal	Oral	Dermal			Oral	Dermal	TOTAL	Oral	Dermal	TOTAL
Potential Carcinogens														
Arsenic	2.13E+01	0.03	1.04E-05	3.63E-05	3.72E-06	1.30E-05	3.0E-04	1.8E+00	3.5E-02	1.2E-01	1.6E-01	6.5E-06	2.3E-05	2.9E-05
Lead	3.72E+03	0.01	1.82E-03	2.11E-03	6.50E-04	7.55E-04	nd	nd	-	-	-	-	-	-
Noncarcinogens														
Barium	4.25E+02	0.01	2.08E-04	2.41E-04	-	-	7.0E-02	-	3.0E-03	3.4E-03	6.4E-03	-	-	-
Cadmium	2.90E+00	0.001	1.42E-06	1.65E-07	-	-	1.0E-03	-	1.4E-03	1.6E-04	1.6E-03	-	-	-
Chromium	6.16E+01	0.01	3.01E-05	3.50E-05	-	-	1.0E+00	-	3.0E-05	3.5E-05	6.5E-05	-	-	-
Mercury	1.90E-01	0.01	9.30E-08	1.08E-07	-	-	3.0E-04	-	3.1E-04	3.6E-04	6.7E-04	-	-	-
Selenium	5.00E-01	0.01	2.45E-07	2.84E-07	-	-	5.0E-03	-	4.9E-05	5.7E-05	1.1E-04	-	-	-
Silver	1.00E+00	0.01	4.89E-07	5.68E-07	-	-	5.0E-03	-	9.8E-05	1.1E-04	2.1E-04	-	-	-
TOTAL											1.65E-01			2.9E-05

Source: ESE.

APPENDIX D
RESULTS OF LEADSPREAD MODEL

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

INPUT		OUTPUT						
MEDIUM	LEVEL	percentiles						
LEAD IN AIR (ug/m ³)	0.04		50th	90th	95th	98th	99th	
LEAD IN SOIL (ug/g)	320	BLOOD Pb, ADULT (ug/dl)	2.0	3.2	3.6	4.1	4.6	
LEAD IN WATER (ug/l)	15	BLOOD Pb, CHILD (ug/dl)	4.4	7.0	7.9	9.1	10.0	
PLANT UPTAKE? 1=YES 0=	0	BLOOD Pb, PICA CHILD (ug/dl)	20.9	32.8	37.1	43.0	47.3	
AIRBORNE DUST (ug/m ³)	50							

EQUATIONS, ADULTS

Blood Pb	Route-specific		concentration		contact rate		percent
Pathway	ug/dl	constant	in medium				of total
SOIL CONTACT:	0.06	= 1E-04 (ug/dl)/(ug/day) *	320 ug/g *	1.85	g soil/day (5 g/m ² * 0.37 m ²)		3%
SOIL INGESTION:	0.14	= 0.018 (ug/dl)/(ug/day) *	320 ug/g *	0.03	g soil/day		7%
INHALATION:	0.09	= 1.64 (ug/dl)/(ug/m ³) *	0.06 ug/m ³				5%
WATER INGESTIO	0.84	= 0.04 (ug/dl)/(ug/day) *	15 ug/l *	1.4	l water/day		42%
FOOD INGESTION:	0.88	= 0.04 (ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *		2.2 kg diet/day		44%

EQUATIONS, CHILDREN (TYPICAL)

Blood Pb	Route-specific		concentration		contact rate		percent
Pathway	ug/dl	constant	in medium				of total
SOIL CONTACT:	0.05	= 1E-04 (ug/dl)/(ug/day) *	320 ug/g *	1.4	g soil/day (5 g/m ² * 0.28 m ²)		1%
SOIL INGESTION:	1.24	= 0.07 (ug/dl)/(ug/day) *	320 ug/g *	0.06	g soil/day		28%
INHALATION:	0.11	= 1.92 (ug/dl)/(ug/m ³) *	0.06 ug/m ³				2%
WATER INGESTIO	0.96	= 0.16 (ug/dl)/(ug/day) *	15 ug/l *	0.4	l water/day		22%
FOOD INGESTION:	2.08	= 0.16 (ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *		1.3 kg diet/day		47%

EQUATIONS, CHILDREN (PICA)

Blood Pb	Route-specific		concentration		contact rate		percent
Pathway	ug/dl	constant	in medium				of total
SOIL CONTACT:	0.05	= 1E-04 (ug/dl)/(ug/day) *	320 ug/g *	1.4	g soil/day (5 g/m ² * 0.25 m ²)		0%
SOIL INGESTION:	17.70	= 0.07 (ug/dl)/(ug/day) *	320 ug/g *	0.79	g soil/day		85%
INHALATION:	0.11	= 1.92 (ug/dl)/(ug/m ³) *	0.06 ug/m ³				1%
WATER INGESTIO	0.96	= 0.16 (ug/dl)/(ug/day) *	15 ug/l *	0.4	l water/day		5%
FOOD INGESTION:	2.08	= 0.16 (ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *		1.3 kg diet/day		10%

EQUATIONS, DIETARY LEAD

TOTAL DIETARY LEAD = 0.945 * 10 + 0.055 * Pb in produce (ug/kg) = 10.0 ug/kg
 LEAD IN PRODUC = 10 ug/kg or 0.00045 * soil lead d = 10.0 ug/kg

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

INPUT		OUTPUT						
MEDIUM	LEVEL	percentiles						
LEAD IN AIR (ug/m ³)	0.04		50th	90th	95th	98th	99th	
LEAD IN SOIL (ug/g)	1000	BLOOD Pb, ADULT (ug/dl)	2.5	3.9	4.4	5.1	5.7	
LEAD IN WATER (ug/l)	15	BLOOD Pb, CHILD (ug/dl)	7.2	11.3	12.9	14.9	16.4	
PLANT UPTAKE? 1=YES 0=	0	BLOOD Pb, PICA CHILD (ug/dl)	58.7	92.0	*****	*****	*****	
AIRBORNE DUST (ug/m ³)	50							

EQUATIONS, ADULTS

Blood Pb		Route-specific	concentration			percent
Pathway	ug/dl	constant	in medium	contact rate		of total
SOIL CONTACT:	0.20 = 1E-04	(ug/dl)/(ug/day) *	1000 ug/g *	1.85 g soil/day (5 g/m ² * 0.37 m ²)		8%
SOIL INGESTION:	0.44 = 0.018	(ug/dl)/(ug/day) *	1000 ug/g *	0.03 g soil/day		18%
INHALATION:	0.15 = 1.64	(ug/dl)/(ug/m ³) *	0.09 ug/m ³			6%
WATER INGESTIO	0.84 = 0.04	(ug/dl)/(ug/day) *	15 ug/l *	1.4 l water/day		34%
FOOD INGESTION:	0.88 = 0.04	(ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *	2.2 kg diet/day		35%

EQUATIONS, CHILDREN (TYPICAL)

Blood Pb		Route-specific	concentration			percent
Pathway	ug/dl	constant	in medium	contact rate		of total
SOIL CONTACT:	0.15 = 1E-04	(ug/dl)/(ug/day) *	1000 ug/g *	1.4 g soil/day (5 g/m ² * 0.28 m ²)		2%
SOIL INGESTION:	3.87 = 0.07	(ug/dl)/(ug/day) *	1000 ug/g *	0.06 g soil/day		54%
INHALATION:	0.17 = 1.92	(ug/dl)/(ug/m ³) *	0.09 ug/m ³			2%
WATER INGESTIO	0.96 = 0.16	(ug/dl)/(ug/day) *	15 ug/l *	0.4 l water/day		13%
FOOD INGESTION:	2.08 = 0.16	(ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *	1.3 kg diet/day		29%

EQUATIONS, CHILDREN (PICA)

Blood Pb		Route-specific	concentration			percent
Pathway	ug/dl	constant	in medium	contact rate		of total
SOIL CONTACT:	0.15 = 1E-04	(ug/dl)/(ug/day) *	1000 ug/g *	1.4 g soil/day (5 g/m ² * 0.25 m ²)		0%
SOIL INGESTION:	55.31 = 0.07	(ug/dl)/(ug/day) *	1000 ug/g *	0.79 g soil/day		94%
INHALATION:	0.17 = 1.92	(ug/dl)/(ug/m ³) *	0.09 ug/m ³			0%
WATER INGESTIO	0.96 = 0.16	(ug/dl)/(ug/day) *	15 ug/l *	0.4 l water/day		2%
FOOD INGESTION:	2.08 = 0.16	(ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *	1.3 kg diet/day		4%

EQUATIONS, DIETARY LEAD

TOTAL DIETARY LEAD = 0.945 * 10 + 0.055 * Pb in produce (ug/kg) = 10.0 ug/kg
 LEAD IN PRODUC = 10 ug/kg or 0.00045 * soil lead d = 10.0 ug/kg

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

INPUT		OUTPUT						
MEDIUM	LEVEL	percentiles						
LEAD IN AIR (ug/m ³)	0.04		50th	90th	95th	98th	99th	
LEAD IN SOIL (ug/g)	3600	BLOOD Pb, ADULT (ug/dl)	4.4	6.8	7.8	9.0	9.9	
LEAD IN WATER (ug/l)	15	BLOOD Pb, CHILD (ug/dl)	17.9	28.1	31.9	36.9	40.6	
PLANT UPTAKE? 1=YES 0=	0	BLOOD Pb, PICA CHILD (ug/dl)	*****	*****	*****	*****	*****	
AIRBORNE DUST (ug/m ³)	50							

EQUATIONS, ADULTS

Blood Pb	Route-specific		concentration		contact rate		percent
Pathway	ug/dl	constant	In medium				of total
SOIL CONTACT:	0.70 = 1E-04	(ug/dl)/(ug/day) *	3600 ug/g *	1.85 g soil/day (5 g/m ² * 0.37 m ²)			16%
SOIL INGESTION:	1.58 = 0.018	(ug/dl)/(ug/day) *	3600 ug/g *	0.03 g soil/day			36%
INHALATION:	0.36 = 1.64	(ug/dl)/(ug/m ³) *	0.22 ug/m ³				8%
WATER INGESTIO	0.84 = 0.04	(ug/dl)/(ug/day) *	15 ug/l *	1.4 l water/day			19%
FOOD INGESTION:	0.88 = 0.04	(ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *	2.2 kg diet/day			20%

EQUATIONS, CHILDREN (TYPICAL)

Blood Pb	Route-specific		concentration		contact rate		percent
Pathway	ug/dl	constant	In medium				of total
SOIL CONTACT:	0.53 = 1E-04	(ug/dl)/(ug/day) *	3600 ug/g *	1.4 g soil/day (5 g/m ² * 0.28 m ²)			3%
SOIL INGESTION:	13.94 = 0.07	(ug/dl)/(ug/day) *	3600 ug/g *	0.06 g soil/day			78%
INHALATION:	0.42 = 1.92	(ug/dl)/(ug/m ³) *	0.22 ug/m ³				2%
WATER INGESTIO	0.96 = 0.16	(ug/dl)/(ug/day) *	15 ug/l *	0.4 l water/day			5%
FOOD INGESTION:	2.08 = 0.16	(ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *	1.3 kg diet/day			12%

EQUATIONS, CHILDREN (PICA)

Blood Pb	Route-specific		concentration		contact rate		percent
Pathway	ug/dl	constant	In medium				of total
SOIL CONTACT:	0.53 = 1E-04	(ug/dl)/(ug/day) *	3600 ug/g *	1.4 g soil/day (5 g/m ² * 0.25 m ²)			0%
SOIL INGESTION:	***** = 0.07	(ug/dl)/(ug/day) *	3600 ug/g *	0.79 g soil/day			98%
INHALATION:	0.42 = 1.92	(ug/dl)/(ug/m ³) *	0.22 ug/m ³				0%
WATER INGESTIO	0.96 = 0.16	(ug/dl)/(ug/day) *	15 ug/l *	0.4 l water/day			0%
FOOD INGESTION:	2.08 = 0.16	(ug/dl)/(ug/day) *	10.0 ug Pb/kg diet *	1.3 kg diet/day			1%

EQUATIONS, DIETARY LEAD

TOTAL DIETARY LEAD = 0 .945 * 10 + 0.055 * Pb in produce (ug/kg) = 10.0 ug/kg
 LEAD IN PRODUC = 10 ug/kg or 0.00045 * soil lead d = 10.0 ug/kg

APPENDIX E
EVALUATION OF AIR EXPOSURE PATHWAY

EVALUATION OF AIR EXPOSURE PATHWAY

1.0 Carcinogenic Risks

To show the contribution of the inhalation pathway to the potential total increased cancer risk associated with soil exposure, the risks for (1) oral exposure, (2) oral + dermal exposure, and (3) oral + dermal + inhalation exposure are calculated for future residential exposure to mean inorganic concentrations in sitewide soils based on DTSC (1994) exposure formulas and parameters. For comparison, the potential increased cancer risk for oral + dermal + inhalation exposure is also calculated based on the EPA (1991a) soil inhalation formula. All parameters for DTSC exposure calculations are in Tables 3-4 and 3-5.

Chemical	Carcinogenic Risks			
	Oral (a)	Oral + Dermal (b)	Oral + Dermal + Inhalation (c)	Oral + Dermal + Inhalation (d)
Arsenic	1.1E-5	1.4E-5	1.6E-5 ^a	1.4E-5 ^b
Cadmium	--	--	2.8E-8	1.2E-10
TOTAL	1.1E-5	1.4E-5	1.6E-5	1.4E-5
^a The inhalation risk calculated using the DTSC formula contributes approximately 9% to the total risk. ^b The inhalation risk calculated using the EPA formula contributes approximately 0.04% to the total risk.				

(a) Oral Exposure using exposure formulas and factors from DTSC (1994).

$$Risk_{oral} = \frac{CSF_o \times C_s \times EF \times CF}{AT_{carc}} \times \left(\frac{IRs_{child} \times ED_{child}}{BW_{child}} + \frac{IRs_{adult} \times ED_{adult}}{BW_{adult}} \right)$$

- (b) Oral and Dermal Exposure using exposure formulas and factors from DTSC (1994).

$$Risk_{oral/derm} = \frac{CSF_o \times C_s \times EF \times CF}{AT_{carc}} \times \left(\frac{IRs_{child} \times ED_{child}}{BW_{child}} + \frac{IRs_{adult} \times ED_{adult}}{BW_{adult}} \right) + \frac{CSF_o \times C_s \times ABS \times AF \times CF}{AT_{carc}} \times \left(\frac{SA_{child} \times EF_{child} \times ED_{child}}{BW_{child}} + \frac{SA_{adult} \times EF_{adult} \times ED_{adult}}{BW_{adult}} \right)$$

- (c) Oral, Dermal, and Inhalation Exposure using exposure formulas and factors from DTSC (1994).

$$Risk_{oral/derm/inh} = \frac{CSF_o \times C_s \times EF \times CF}{AT_{carc}} \times \left(\frac{IRs_{child} \times ED_{child}}{BW_{child}} + \frac{IRs_{adult} \times ED_{adult}}{BW_{adult}} \right) + \frac{CSF_o \times C_s \times ABS \times AF \times CF}{AT_{carc}} \times \left(\frac{SA_{child} \times EF_{child} \times ED_{child}}{BW_{child}} + \frac{SA_{adult} \times EF_{adult} \times ED_{adult}}{BW_{adult}} \right) + \frac{CSF_i \times C_s \times 0.05 \times EF \times CF}{AT_{carc}} \times \left(\frac{IRa_{child} \times ED_{child}}{BW_{child}} + \frac{IRa_{adult} \times ED_{adult}}{BW_{adult}} \right)$$

- (d) Oral and Dermal Exposure using exposure formulas and factors from DTSC (1994), and Inhalation Exposure using exposure formula and factors from EPA (1991b, 1992).

$$Risk_{oral/derm/inh} = \frac{CSF_o \times C_s \times EF \times CF}{AT_{carc}} \times \left(\frac{IRs_{child} \times ED_{child}}{BW_{child}} + \frac{IRs_{adult} \times ED_{adult}}{BW_{adult}} \right) + \frac{CSF_o \times C_s \times ABS \times AF \times CF}{AT_{carc}} \times \left(\frac{SA_{child} \times EF_{child} \times ED_{child}}{BW_{child}} + \frac{SA_{adult} \times EF_{adult} \times ED_{adult}}{BW_{adult}} \right) + \frac{CSF_i \times C_s \times (1/PEF) \times EF}{AT_{carc}} \times \left(\frac{IRa_{child} \times ED_{child}}{BW_{child}} + \frac{IRa_{adult} \times ED_{adult}}{BW_{adult}} \right)$$

Where: PEF = 4.63×10^9 .

2.0 Noncarcinogenic Hazards

To show the contribution of the inhalation pathway to the total hazard index (HI) associated with soil exposure, the HIs for (1) oral exposure, (2) oral + dermal exposure, and (3) oral + dermal + inhalation exposure are calculated for future residential exposure to mean inorganic concentrations in sitewide soils based on DTSC (1994) exposure formulas and parameters. For comparison, the HI for oral + dermal + inhalation exposure is also calculated based on the EPA (1991a) soil inhalation formula. All parameters for DTSC exposure calculations are in Tables 3-4 and 3-5.

Chemical	HIs			
	Oral (a)	Oral + Dermal (b)	Oral + Dermal + Inhalation ^a (c)	Oral + Dermal + Inhalation ^a (d)
Arsenic	0.16	0.21	0.21	0.21
Barium	0.0099	0.011	0.028	0.011
Cadmium	0.0075	0.0076	0.0076	0.0076
Chromium	0.00021	0.00023	0.00023	0.00023
Mercury	0.0026	0.0028	0.0028	0.0028
Selenium	0.0013	0.0014	0.0014	0.0014
Silver	0.0026	0.0028	0.0028	0.0028
TOTAL	0.18	0.24	0.26 ^b	0.24 ^c
^a Inhalation RfCs/RfDs are available only for barium and mercury. ^b The total inhalation HI calculated using the DTSC formula contributes approximately 7% to the total HI. ^c The total inhalation HI calculated using the EPA formula contributes approximately 0.03% to the total HI.				

- (a) Oral Exposure using exposure formulas and factors from DTSC (1994).

$$HI_{oral} = \frac{C_s \times IRs_{child} \times EF \times ED_{child} \times CF}{RfD_{oral} \times BW_{child} \times AT_{noncarc}}$$

- (b) Oral and Dermal Exposure using exposure formulas and factors from DTSC (1994).

$$Risk_{oral/derm} = \frac{C_s \times IRs_{child} \times EF \times ED_{child} \times CF}{RfD_{oral} \times BW_{child} \times AT_{noncarc}} + \frac{C_s \times ABS \times AF \times SA_{child} \times EF_{child} \times ED_{child} \times CF}{RfD_{oral} \times BW_{child} \times AT_{noncarc}}$$

- (c) Oral, Dermal, and Inhalation Exposure using exposure formulas and factors from DTSC (1994).

$$Risk_{oral/derm/inh} = \frac{C_s \times IRs_{child} \times EF \times ED_{child} \times CF}{RfD_{oral} \times BW_{child} \times AT_{noncarc}} + \frac{C_s \times ABS \times AF \times SA_{child} \times EF_{child} \times ED_{child} \times CF}{RfD_{oral} \times BW_{child} \times AT_{noncarc}} + \frac{C_s \times 0.05 \times IRa_{child} \times EF \times ED_{child} \times CF}{RfD_{inh} \times BW_{child} \times AT_{noncarc}}$$

- (d) Oral and Dermal Exposure using exposure formulas and factors from DTSC (1994), and Inhalation Exposure using exposure formula and factors from EPA (1991b, 1992).

$$Risk_{oral/derm/inh} = \frac{C_s \times IRs_{child} \times EF \times ED_{child} \times CF}{RfD_{oral} \times BW_{child} \times AT_{noncarc}} + \frac{C_s \times ABS \times AF \times SA_{child} \times EF_{child} \times ED_{child} \times CF}{RfD_{oral} \times BW_{child} \times AT_{noncarc}}$$

$$+ \frac{C_s \times (1/PEF) \times IRa_{child} \times EF \times ED_{child}}{RfD_{inh} \times BW_{child} \times AT_{noncarc}}$$

Where: PEF = 4.63×10^9 .